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REVIEW ARTICLE

RADIOGRAPHIC COMPARISON OF GUIDED BONE REGENERATION WITH RESORBABLE AND NON-RESORBABLE MEMBRANES IN DENTAL IMPLANT CASES - A SYSTEMATIC REVIEW

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ABSTRACT

Aim: Which membrane out of resorbable and non-resorbable membrane is better when used for guided bone regeneration in dental implant cases?

Materials and Methods: A systematic review of articles selected from MEDLINE, Clinical trials registry (India) and Google Scholar was carried out. Additional studies were hand searched. Only randomised controlled trials (RCTs) published from 1st January 1995 to 30th September 2015 were included in this study. These studies compared the resorbable and non-resorbable membranes used for guided bone regeneration in cases to be treated with implant placement.

Results: A total of 172 articles were identified through electronic database. 170 articles were obtained after elimination of duplicates which were then screened. 16 full-text articles were accessed for eligibility criteria. 8 trials were identified for inclusion in this review, comparing the test group (non-resorbable membranes) with the control (resorbable membranes.)

Conclusions: The use of a membrane definitely contributes to the regeneration of the hard tissue in bone augmentation. The complete fill of the defect was obtained with Polyglactic-910 (resorbable membrane). No substantial differences were observed comparing non-resorbable ePTFE membranes and resorbable membranes.

Limitation: Only one electronic database search was done and only full-text articles in english were included. Only 13 trials were included and the majority are of limited sample size, and have short follow-ups.

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INTRODUCTION

Prosthetic restorative treatment has been immensely affected due to dental implants which are anchored in the maxillary and mandibular bone with direct bone to implant interface (Albrektsson *et al.,* 1981; Brånemark, 1985). A sufficient quantity of bone is an important preoperative factor for long-term successful oral implant therapy (Lekholm and Zarb, 1985). If insufficient horizontal bone is present it may lead to exposed implant sites, peri implant soft tissue irritation, reduced bone implant surface and consequently failure of the implant. A number of clinical studies have proved that guided bone regeneration techniques successfully improve the healing of bony defects and also help in increasing the height and width of atrophic alveolar ridges before implant placement (Dahlin *et al.,* 1989; Becker *et al.,* 1990; Buser *et al.,* 1990; Dahlin *et al.,* 1991; Buser and Dula, 1993; Simion *et al.,* 1992; Nevins and Mellonig, 1992; Mellonig and Triplett, 1993; Jovanovic *et al.,* 1992). Ideal amount of bone and soft tissue are hold a very important place in the success of implant dentistry. The alveolar process is often affected after tooth loss, augmentation is usually indicated to achieve optimum results. For majority of patients, who have one or more missing teeth, ridge augmentation has become a requirement for implants to last longer and for their esthetic use. Horizontal bone augmentation, which increases recipient bone width in the bucco-lingual direction, and vertical bone augmentation, which is focused on increasing the height of the recipient bone are the two augmentation procedures available for implant sites (Esposito *et al.,* 2009). Bone augmentation can be performed before or during implant placement (Esposito *et al.,* 2009). The commonly used graft materials are allografts, aloplastic material, xenograft or autogenous bone along with barrier membranes for horizontal bone augmentation (Zitzmann *et al.,* 1997; Merli *et al.,* 2006; Chiapasco *et al.,* 2009; Merli *et al.,* 2015). In bone reconstruction procedures, autogenous bone grafts augment bone regeneration (Buser *et al.,* 1990 & 1993;

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Simion *et al.,* 1994; Becker *et al.,* 1995). Autogenous bone grafts are able of maintaining an adequate space under the membrane for a sufficient period of time, and they get easily resorbed and replaced by vital bone. The overlying tissue also turns out to be well contoured and well grown. By transference of stimulating factors incorporated in the bone matrix the mineralized bone conduces and induces bone formation (Cushing, 1969; Burwell. 1964). The purpose of guided bone augmentation is the use of membranes to exclude epithelial cells and permit the migration of the osteoblasts) to implant site (Ha¨mmerle and Jung, 2003). Due to their early successful application e-PTFE are regarded as the standard for guided bone regeneration (Dahlin *et al.,* 1991a & 1991b; Davarpanah *et al.,* 1991). However, the major drawback of this membrane is that it is non-resorbable and causes bacterial contamination during surgical removal in second stage surgery (Simion *et al.,* 1998; Machtei, 2001). Also an inflammatory reaction which would require early membrane removal. Resorbable membranes are therefore used for their more desirable consequences over non resorbable membranes. The objective of this systematic review of RCT's is to compare bioabsorbable and non-bioabsorbable membranes for guided bone augmentation in implant sites which will provide a lot of helpful information for clinicians and help them choose a more suitable treatment option for guided bone regeneration. This study also contributes to a better understanding towards guided bone regeneration options to avoid implant failures.

MATERIALS AND METHODS

PICO

P - Participants: Patients treated with guided bone regeneration for dental implant placement.
I - Intervention: Radiographic evaluation of amount of both growth with Resorbable membranes used for guided bone augmentation for implant placement.
C - Comparison: Radiographic evaluation of amount of both growth with Non-resorbable membranes used for guided bone augmentation for implant placement.
O - Outcomes: Quantity of Guided bone regeneration
S - Study designs: Clinical trials

ELIGIBILITY CRITERIA

Inclusion criteria

- Eligible studies included randomized clinical trials.
- Eligibility criteria were good health, any age groups and either sex.
- Pubmed search which includes articles published from 1st January 1995 upto 30th September 2015.
- The studies that provide information about cases to be treated or already treated with dental implants using a bioabsorbable or a non-bioabsorbable membrane for guided bone augmentation only in healthy polpulation were included.
- Studies that provided a follow-up period of atleast 5 months.
- Outcome primary variables included were radiological examination which revealed the amount of bone fill (in %) after the follow up period.
- Only radiological data was considered for assessment.
- Only studies written in English were accepted.

Exclusion criteria

- Reviews, case reports, abstracts, editorials, letters, and historical reviews and in vitro studies were not included in the review.
- Studies in diseased population.

Information sources

Internet sources that were used for the search of relevant papers from Medicine (MEDLINE PubMed), Google Scholar, Google, Clinical trials registry (India) and manual search using DPU college library resources. Cross reference of the chosen studies were scrutinized for articles fulfilling the inclusion and exclusion criteria of the study. The databases were again scrutinised from 1st January 1995 up to 30th September 2015 using the formulated search strategy.

Study selection

Preliminary screening consisted total of 172 articles out of which 20 articles were selected. The studies were screened independently by one of the contributory author (PD). Initially the articles were screened by title and abstract reading. For full-text screening was done, with a follow up of atleast 5 months and studies which compared bioabsorbable membranes and non-bioabsorbable membranes for guided bone regeneration in cases to be treated with implants. Finally a total of 08 articles were included. Also a filter was set for the search which included only human studies full text English articles from 1st January 1995 to 30th September 2015.

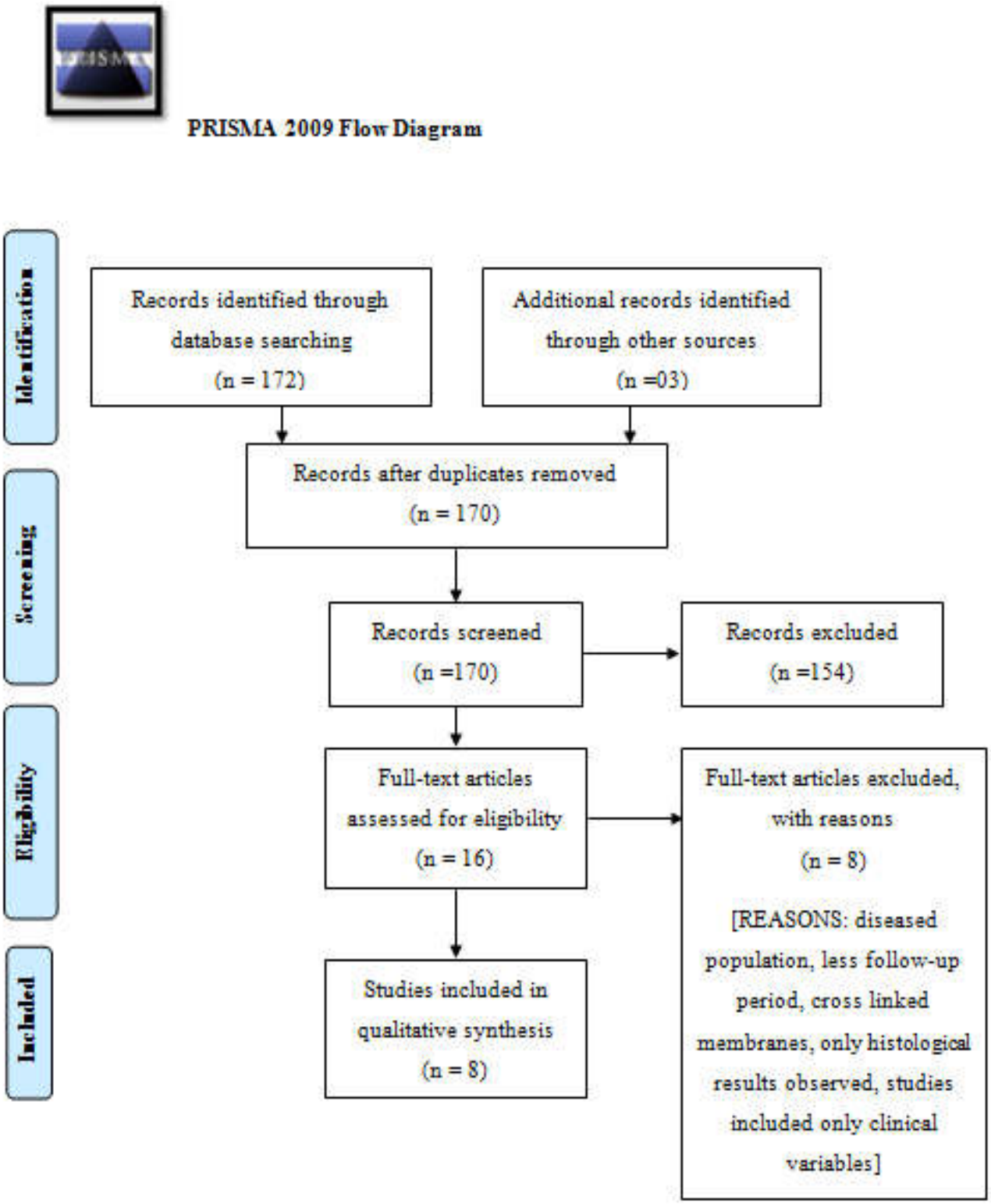
Data Collection Process

A standard pilot form in excel sheet was initially used and then all those headings not applicable for review were removed. Data extraction was done for one article and this form was reviewed by an expert and finalized. This was followed by data extraction for all the articles.

DISCUSSION

On a whole, the entire review data is not sufficient for a definite determination as to which membrane is best for use in implant dentistry. Only 13 randomised controlled trials were included and most of them had low sample size and short follow up periods. However, several statements can be made on the basis of this systematic review.

Christgau *et al.,* in 1995 studied resorbable and non-resorbable GTR-membranes on radiographical and clinical parameters. They performed a comparison of the 5 months after placing Polyglactin-910 (resorbable) and e-PTFE i.e non-resorbable membranes. 12 physically and mentally sound patients with 41 defects were included for the study. The resorbable membrane Polyglactin-910 after 5 months on radiographical examination revealed 100% bone fill with a standard deviation of 2.06. Whereas, non resorbable membrane i.e. an increase of 75% in bone regeneration was observed using e-PTFE with standard deviation of 1.84. This 5 months study, concluded that, the bioabsorbable membranes provid better attachment gain compared to the e-PTFE i.e non resorbable membranes.



Massimo Simion *et al.,* in 1997 studied the efficacy of polylactic acid (resorbable) and polyglycolic acid resorbable membranes and e-PTFE non bioabsorbable membrane along with autogenous bone grafts when used to treat implant dehiscence or fenestrations. 18 implants in a total of nine patients participated in this study. Nine i.e half of the defect number were augmented with resorbable membrane; PLA/PGA membranes, and the other half were treated with non bioabsorbable membrane; expanded polytetrafluoroethylene membranes. Stage-II surgery took place after 6 to 7 months of healing. The non resorbable membrane i.e e-PTFE group exhibited higher percentage of bone fill which was (98.20%) than in the resorbable membrane PLA/PGA group which was 88.56%, but the difference was not statistically significant (P = .207). This study proved that resorbable and the non resorbable membranes are equally effective in the treatment of lack of bone in dental implant cases. Nicola U. Zitzmann *et al.,* in 1997 performed a clinical study comparing resorbable collagen membrane, Bio-Gide, to non resorbable expanded polytetrafluoroethylene material (Gore-Tex) for guided bone augmentation in patients involving exposed implant sites. Within 2 years, 25 patients were treated randomly: one of the defect was treated with Bio-Gide and the other defect site was treated with Gore-Tex; the entire number

Table 1. Study characteristics

Study ID	Author	Year of publication	Study design	Sample size(no. of Patients)	Intervention (Resorbable membrane)	Comparison (Non-resorbable membrane)	Healing time before clinical examinations	Radiographical finding for intervention (amount of bone fill)	Radiographical finding for comparison (amount of bone fill)	Standard deviation for radiographical findings of intervention	Standard deviation for radiographical findings of comparison	REMARK
1	M.Christgau	1995	RCT	12	Polyglactic-910	(e-PTFE)	5 months	100%	75%	2.06	1.84	Resorbable membrane shows a better bone fill percentage
2	Massimo Simion	1997	RCT	9	Poly (glycolic acid)	(e-PTFE)	6 Months	88.56%	98.20%	21.7	3.6	Non-Resorbable membrane exhibited a better bone fill percentage
3	Nicola U	1997	RCT	25	Porcine collagen	(e-PTFE)	6 Months	92%	78%	19.3	50.2	Resorbable membrane exhibited a better bone fill percentage
4	Martin Lorenzoni	1998	RCT	82	Biofix	(e-PTFE)	5.5 Months	84%	60%	_	_	Resorbable membrane exhibited a better bone fill percentage
5	Majzouib Z	1999	RCT	9	Laminar bone sheets	GTAM	8 Months	75.17%	86.70%	26.62	27.94	Non-Resorbable membrane exhibited a better bone fill percentage
6	Lillian Carpio	2000	RCT	48	Porcine-derived collagen	(e-PTFE)	6 months	39.60%	45.90%	_	_	Non-Resorbable membrane exhibited a better bone fill percentage
7	Ofer Moses	2005	RCT	86	Ossix	(e-PTFE)	6-8 Months	79.56%	75.26%	21.32	24.36	Resorbable membrane exhibited a better bone fill percentage
8	Ronal E Jung	2008	RCT	37	Collagen membrane	PEG hydrogel membrane	6 months	94.90%	96.40%	_	_	Non-Resorbable membrane exhibited a better bone fill percentage

of defects (84) were filled with Bio-Oss and covered with membrane. The defect types, their dimensions, and their morphology were measured in detail initially and at re-entry to allow for calculation of the exposed implant surface. The mean average percentage of bone regeneration was 92% (sd= 19.3) for Bio-Gide and 78% (sd = 50.2) for Gore-Tex sites. The resorbable membrane, Bio-Gide, is useful alternative to the well-established non resorbable e-polytetrafluoroethylene membranes. Martin Lorenzoni *et al.,* in 1998 performed a clinical study, in which a resorbable membrane i.e Biofix as well as two membranes made of e-polytetrafluoroethylene were studied for their potential to promote osteogenesis. Among 46 implants that were augmented with Gore-Tex membranes, another 45 implants were treated with titanium-reinforced Gore-Tex membranes, and thirty eight defects were treated with Biofix. The results thus proved that use of membranes definitely affects the success of bone augmentation procedures. The average rate of bone augmentation with non bioabsorbable membranes was 84% for GTAM and and 81% for TR-GTAM radio graphically.

The use of Biofix membranes (resorbable) resulted in a total bone gain of 60%. Majzoub *et al.,* in 1999 designed a studied the regeneration at exposed implant sites of the resorbable demineralized laminar bone sheets and GTAM membranes. Seven healthy patients were treated applying the GBR principles and they received either laminar bone sheets or GTAM membraties. After a follow-up period of 8 months the cases treated with resorbable membrane i.e laminar bone sheets resulted in a bone fill of 75.1% (SD = 26.62) and those treated with non-resorbable membrane i.e GTAM showed a bone fill of 86.70 % (SD = 27.94) Thus this study showed a better bone fill by using non-resorbable membrane as compared to resorbable membranes.

Lillian Carpio *et al.,* in 2000 conducted a study on guided bone augmentation around implants by using anorganic bovine bone material compared to Porcine-derived collagen which is a resorbable membrane and polytetrafluroethylene which is a non-resorbable membrane. After 6 months, radiographical examination revealed 39.60% bone fill with Porcine-derived collagen membrane. Whereas, non resorbable membrane i.e. e-

PTFE on radio graphical examination showed an increase of 45.90% in bone fill. Based on this 6 month study, the non-resorbable membranes provided attachment gain similar to the resorbsable membranes. Ofer Moses *et al*., in 2005 studied healing of defects in implants placed together with membranes. The radiographical examination after 6-8 months revealed 79.56% bone fill (SD = 29.32). Whereas, non resorbable membrane i.e. e-PTFE on radiographical examination showed an increase of 75.20 % in bone fill (SD=24.36). Based on this 6 months, the bioabsorbable membranes provided attachment gain similar to the non-bioabsorbsable membranes. Ronald E. Jung *et al.,* in 2008 evaluated guided bone augmentation around implants. Their aim was to test whether a synthetic bioresorbable polyethylene glycol (PEG) hydrogel membrane could was as gud as collagen membrane for vertical bone regeneration. The radiographical examination revealed 94.90% bone fill in cases treated with biabsorbable collagen membrane. Whereas, non bioabsorbable membrane i.e. PEG hydrogel membrane on radiographical examination showed an increase of 96.90% in bone fill.

Conclusion

Overall, the evidence is not sufficient to determine which membrane among resorbable and non resorbable is the best treatment for guided bone regeneration for implant placement. it was concluded that, the use of a membrane can contribute to the regeneration of the hard tissue in bone augmentation. Complete bone fill was observed with Polyglactic-910 resorbable membrane. However, no substantial differences were observed comparing non resorbable ePTFE membranes and resorbable collagen membranes.

Implication for research

We would recommend more studies be done on guided bone regeneration so that we can obtain a substantial result for this study. Also, all Randomised controlled trial studies should use CONSORT as their search database. We recommend authors to conduct studies with longer follow-up periods and more number of patients. Authors should also consider newer materials for research.

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