



## REVIEW ARTICLE

# TRENDS IN RESTORING ATROPHIED MANDIBULAR RIDGES WITH IMPLANTS OVER A PERIOD OF THREE DECADES

\*Dr. Mansi Jain, Dr. Nilesh Bulbule and Dr. Nayana Anasane

Department of Prosthodontics and Crown & Bridge, Dr. D. Y. Patil Dental College, Pimpri, Pune

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### ABSTRACT

**Aim:** The aim was to see the changing trends while restoring resorbed mandibular ridges with different implant designs.

**Methods:** A systematic search was conducted in pubmed, Google Scholar and major journals for studies published between 1985 - 2015. The era was divided into three decades and the number of cases in rehabilitation of resorbed mandibular ridges irrespective of the pre prosthetic surgeries for the implant site where taken into consideration. Patient in the age range of 16 - 75 years of age where included in the study. The number of implants used for successful placement of prosthesis where included in the study.

**Discussion:** With the wide variety of options present selecting a particular type has been difficult, especially when treating resorbed mandibular ridges. Basal implants represent a good alternative to the regular dental implants. With the difference in philosophies of the two implants there arises a need to see the clinical evaluation of a better option for restoring resorbed mandibular ridges.

**Conclusion:** An increasing trend was found in the use of crestal implants. Considering the advantages, disadvantages and post - operative complications crestal implants suggested to be of better choice when compared to the basal implants.

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## INTRODUCTION

Dental implants are believed to have been used since Egyptian times. Although the currently used titanium root-form implants are a virtually serendipitous discovery from the 1950s by Dr. Per Ingvar Brånemark of Gothenburg Sweden. (Abu-Hussein et al., 2014) Since their introduction, dental implants, that are tooth-root analogue devices inserted into the jaw-bone (endosseous), have been increasingly used to support different types of dental prostheses, such as fixed partial dentures, fixed complete dentures and removable complete dentures (The glossary of prosthodontic terms, 2005; Kibrick et al., 1975; Abu-Hussein and Abdulgani, 2014). In 2002, two dental implants in the mandible to support removable complete dentures were advocated as the minimum standard of care for edentulous individuals by a panel of expert clinicians and scientists (Abu-Hussein and Abdulgani, 2014). This consensus stemmed from a decade of longitudinal clinical studies that signify the clinical benefits and patient satisfaction with mandibular two-implant overdentures over conventional dentures. It does not take many implants to set up an implant-

based fixed denture system that can support a stable, immobile bridge on a twisting and rather unstable underlying mandible—similar to an external fixating device. In recent years, two schools of thought have emerged in the area of basal osseointegration:

1. The French school of Scortecchi and others favours restoring even severely atrophied mandibular ridges by using a large number of basal osseointegrated implants (BOI), usually 7 to 12 implants. This school combines BOI with screw implants, both in the maxilla and in the mandible. The implant systems thus established are immobile and do not allow jaw regions to change their relative orientation.
2. In the German-speaking countries there is a tendency to favour restoring the edentulous mandible using only a few BOIs, usually inserting four implants in regions 47, 43, 33, and 37, even when providing fixed dentures. This type of implant system is referred to as "flexible" because it permits mandibular shifts and flexion below the fixed superstructure, despite the fact that the load-transmitting segments of the basal implant osseointegrate. The long threaded pins between the load-transmitting osseointegrated disks and the bridge serve as flexible interfaces.

\*Corresponding author: Dr. Mansi Jain,

Department of Prosthodontics and Crown & Bridge, Dr. D. Y. Patil Dental College, Pimpri, Pune

The atrophied mandibular ridge rarely offers enough vertical bone for implant insertion, but, as can be readily palpated; there is usually sufficient available bone in the horizontal plane. The bone is optimally utilized by BOI implants inserted horizontally. It was shown, however, that BOI suffered from the influence of jaw flexibility in the regions of the second premolars and first molars, resulting in inferior osseointegration of the force-transmitting disks. But because this had no consequences on the stability of the overall design, the prosthodontic structures could be preserved in all cases. The non-removable reconstruction of the atrophic mandible is possible with basal osseointegrated implants in an immediate-load procedure. Between 4 and 5 implants are necessary to form a reliable foundation for a fixed bridge. A severely resorbed mandible poses a true challenge to the clinician while fabricating complete dentures. Tooth extraction is followed by a loss of bone width by 25% and a loss in bone height of 4 mm during the first year. (Carlsson and Persson, 1967) With removable denture wearers, bone loss continues over the years. The absence of the alveolar ridge compromises the retention and stability of the dentures. Implants supported over dentures have proven to be a viable option to treat such patients. Implants not only provide continuous stimulation to the bone, leading to minimal bone loss, they also improve the overall retention and stability of the prosthesis. Implants supported over dentures are predictably and significantly better than conventional complete dentures. (Burns *et al.*, 1995; Feine *et al.*, 1969)

Several attachment systems are available, such as ball attachments, bars, clips, and O-ring attachments and magnets. The attachments are selected based on the type of prosthetic movement encountered. The success of titanium endosseous screw-shaped implants, developed in Sweden by Professor P-I Brånemark beginning in the early 1960s, has demonstrated that edentulous jaws can be reconstructed using osseointegrated Brånemark implants with predictable long-term success. (Adell *et al.*, 1970; Brånemark *et al.*, 1977; Adell *et al.*, 1981; Albrektsson *et al.*, 1981; Brånemark *et al.*, 1982; Adell *et al.*, 1983; Brånemark *et al.*, 1983; Adell, 1985; Albrektsson *et al.*, 1986; Albrektsson *et al.*, 1988; Ahlqvist *et al.*, 1990) In practical clinical terms, the minimal bone volume for the smallest Brånemark implant is 8 mm in height and 6 mm in width. (Lekholm and Zarb, 1985; Shulman, 1988) Therefore, most patients may be orally rehabilitated using conventional techniques for implant placement. However, there are a number of patients who do not meet this minimal bone requirement because of inadequate height and/or width of the alveolus and/or the presence of anatomic structures such as the maxillary sinus, nasal cavity, incisive canal, labial bone concavities, and the mandibular nerve. Bone grafting is commonly used in oral and maxillofacial surgery for procedures such as the secondary osseous reconstruction of alveolar and palatal clefts, (Boyne, 1991) orthognathic surgery (Bell *et al.*, 1980), and osseous reconstruction following tumour ablative surgery (Buchbinder *et al.*, 1989) or severe trauma (Boyne, 1969), and in alveolar augmentation. Reports of the use of autogenous bone grafts with titanium implants for rehabilitation of the severely resorbed maxilla and mandible are occurring with increasing frequency in the literature. (Breine and Brånemark, 1980; Keller *et al.*, 1987; Listrom and Symington, 1988; Kahnberg *et al.*, 1989; Laney and Tolman, 1989; Jensen *et al.*, 1990; Collins, 1991; Adell *et al.*, 1990; Nystrom *et al.*, 1993; Keller and Tolman, 1992; Keller *et al.*, 1988; Cain *et al.*, 1993; Lew *et al.*, 1991; Donatsky *et al.*,

1993) In addition, reports on grafting with delayed placement of implants are now on the increase and suggest an overall success rate of 75%. (Keller *et al.*, 1987; Listrom and Symington, 1988; Kahnberg *et al.*, 1989; Laney and Tolman, 1989; Jensen *et al.*, 1990; Collins, 1991; Adell *et al.*, 1990; Cain *et al.*, 1993) With this background, a prospective study was designed to understand the changing trends in restoration of the resorbed mandible using either basal osseointegrated implants or endosseous implants.

**Focused question:** Which type of implants whether the regular or basal osseointegrated implants are more suitable for the restoration of atrophied mandibular ridges?

**Objective:** To compare restoration of atrophied mandibular ridges using basal osseointegrated implants and regular dental implants?

## MATERIALS AND METHODS

This particular study was designed to study the various treatment modalities while restoring a resorbed mandibular ridge with the different types of implant design available.

**Eligibility criteria:** While searching for the research material for this particular study following criteria were followed.

### Inclusion criteria:

- 1) Articles in English or those having detailed summary in English where selected.
- 2) Studies published between 1st January 1985 and 31st December 2015.
- 3) Studies that provide information about cases already treated using regular dental implants or basal osseointegrated dental implants for atrophied mandibular ridges irrespective of the pre-prosthetic surgeries.
- 4) Studies providing information for age more than 16 years and less than 75 years of either sex.

### Exclusion criteria

- 1) Letters to editors, editorials and in vitro studies are excluded.
- 2) Studies that provide information for age more than 75 years of age.
- 3) Studies in diseased population where not considered.

### Information sources

- To find the relevant materials and articles from various sources the keywords used were basal implants, crestal implants, resorbed / atrophied mandible and their synonyms.
- The selected articles were obtained from electronic search on sites like google scholar, hand search and cross searches.
- Total number of articles obtained where 40 and after text searching 11 number of articles were selected according to the guidelines followed.

### Study selection

- The articles relevant for the study were collected from various sources like electronic search from particular sites like Pubmed & Google Scholar.

- The outcome or the result of the study of articles was derived from the clinical evaluation of the treated cases, no diagnostic means were used to study the outcome.
- The outcome of the study was evaluated based on the successful prosthetic treatment of cases.

**Data collection:** The particulars were followed for deriving the data from the articles where :

- P – Participants: patients treated with regular dental implant placement and basal osseointegrated dental implants.
- I – Intervention: basal osseointegrated implant placement.
- C – Comparison: regular dental implants placed.
- O – Outcomes: osseointegration of implants with bone. Reduced treatment time.
- S – Study designs: clinical evaluation

#### 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

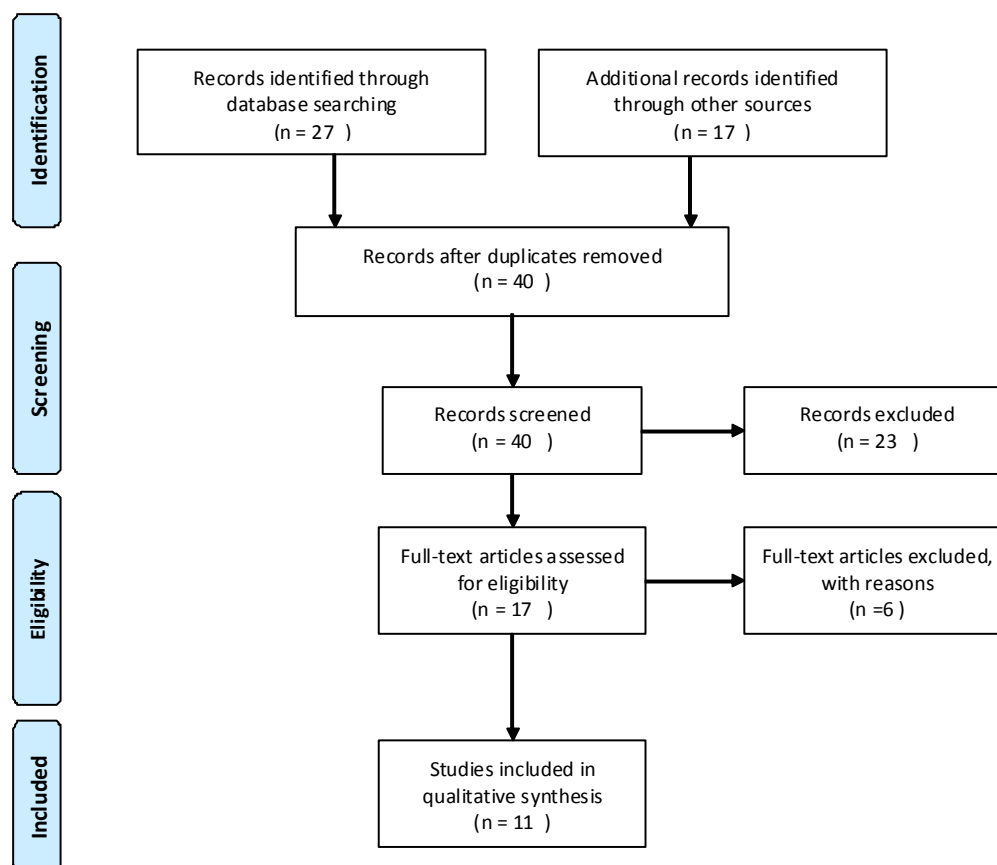
#### Data items

1. Study ID – the decade in which study was conducted.
2. Author – the author who conducted study
3. Year of publication – the year in which article was published
4. Study design – the type of clinical study carried out.
5. Sample size – the number of patients on which intervention was carried out.
6. Setting – the clinical set up in which the interventions were carried out.
7. Product – the different type of implants used.
8. Intervention – the number of implants placed
9. Outcome – the number of successfully placed implants restored with prosthesis.
10. Outcome value – the number of successful implants
11. Other relevant information – the number of failed implants, if any.

## RESULTS

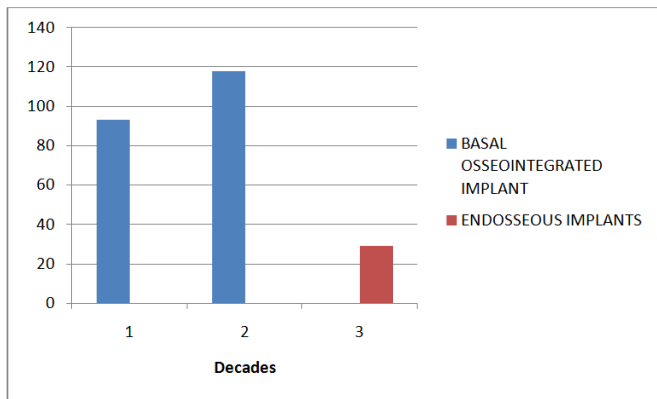


#### PRISMA 2009 Flow Diagram



**Chart**

- x- axis – represents decade
- y - axis represents number of implants.



**EXCEL SHEET**

Study ID	Author name	Year of publication	Study design	Sample size	Product	Intervention/exposure	Outcome	Time	Outcome effect	Other relevant information
1985 - 1995										
article 1	Ole Donatsky	1993	randomised control trial	25	Branemark osseointegrated implants	93 implants where placed in 25 patients	90 successful implants with prosthesis where delivered	27 months of	successful placement of prosthesis	3 failed implants
1995 - 2005										
article 1	Stefan Idhe	2001	case report	1	Basal osseointegrated implants	4 basal implants where placed	successful 4 implants and prosthesis	follow up	successful 4 implants and prosthesis	
article 2	Raymond Allan	1996	randomised control trials	29 patient	Branemark osseointegrated implants	114 implants in 30 patients	114 successful implants with prosthesis delivered		successful 114 implants	
2005 - 2015										
article 1	Marija Babulo et al	2011	case report	1 patient	3M IMTEC implants	4 mini implants where placed	4 successful implant		4 successful implants with prosthesis	
article 2	Jaswinder Kaur	2015	case report	1 patient	osseointegrated implants	2 implants where placed	2 successful implant	2 year follow up	2 successful implant with prosthesis	
article 3	Esma B Gul	2015	case series	2 patients	Astra Tech Dental Implants	4 implants in one patient & 6 implants in second patient	10 successful implants in both the patients	one year follow up	10 successful implants with prosthesis	
article 4	Prashant Eachempati	2014	case report	1 patient	osseointegrated implants	2 implants where placed	2 successful implants	one year follow up	2 successful implants with prosthesis	
article 5	Abdulgani Azzaldeen	2015	case report	1 patient	endosseous implants	2 implants where placed	2 successful implants with prosthesis	follow up of 10 year	2 successful implant with prosthesis	
article 6	Farhan Durrani	2015	case report	1 patient	osseointegrated implants	4 implants where placed	4 successful implant		4 successful implants with prosthesis	
article 7	Dr. Kirti Jajoo	2015	case report	1 patient	osseointegrated implants	2 implants where placed	2 successful implants with prosthesis		2 successful implants with prosthesis	
article 8	Dr. Amit Khattak	2015	case report	1 patient	osseointegrated implants	3 implants where placed	3 successful implants		3 successful implants with prosthesis	

**DISCUSSION**

Ole Donatsky in 1993 decided to study the Branemark dental implants along with ball attachments as an alternative to the lingual vestibuloplasty and free split thickness skin graft and removable denture in 25 consecutive patients with alveolar ridge atrophy in mandibular ridge. All 93 fixtures were without peri-implant radiolucency and were immobile when evaluated in relation to abutment connection 3 to 4 months after fixture placement (i.e., a primary bone healing success rate of 100%). The observation period after abutment connection and placement of the prosthesis varied from 12 to 27 months. All 25 overdentures were in function; thus the corresponding prosthesis function rate was 100%. All 25 patients were followed for at least 1 year. Gingival tenderness, oedema, and mild hyperplasia were seen from time to time around the abutments. These sequelae were caused by trauma from the overdenture and/or poor oral hygiene. Occasionally, destruction

of an attachment plastic cap was reported. (Donatsky, 1993) Raymond Allan Williamson (1996) in 1996 studied 29 consecutively treated patients who underwent a variety of autogenous alveolar augmentation procedures to their resorbed maxilla or mandible followed by delayed placement of Brånemark dental implants. Thirty patients had a total of 114 implants placed as a delayed procedure in the grafted areas of their severely resorbed mandible or maxilla; 12 implants were removed. The success rate for implant integration in this study overall for both jaws were 89.5%. When taken separately, the success rate in the mandible was 100% and in the maxilla was 85.5%. Stefan Idhe in 2001 advocated the use of basal osseointegrated implants with immediate loading. Between 4 and 5 implants are necessary to form a reliable foundation for a fixed bridge especially in resorbed mandibular ridges. MarijaBubalo *et al.* in 2011 advocated the use of mini dental implants and iliac bone crest graft for the rehabilitation of the severely resorbed mandibular ridges. The analysis of the new orthopantomogram demonstrated that the alveolar ridge height was increased by about 10 mm, and that width was not

increased that much – partial transplant resorption perhaps took place. In local infiltration anaesthesia, after the elevation of the mucoperiosteal flap, 4 mini dental implants were placed (3M IMTEC, MDI Collared Intermediate O-Ball 2.1 mmx13 mm) in the regions 31, 33, 41, 43. Jaswinder Kaur in 2015 advocated the use of implant supported complete denture as a most efficient alternative for resorbed mandibular ridges. Existing denture of patient was found to be satisfactory in occlusion, stability and aesthetics. So same prosthesis was planned to be converted into implant supported overdenture. Esma B GÜL *et al.* in 2011 advocated the use of hybrid prosthesis on tilted implants in cases of severely resorbed mandibular ridges. A total of 12 implants (Astra Tech Dental, Mölnadal, Sweden) were placed, 6 in the maxilla (4.0x13 (16), 3.5x13 (12), 3.5x11 (14), 4.0x11 (22), 4.0x11 (24), 3.5x11 (25)) and 6 in the mandible (3.5x13 (32), 3.5x8 (34), 3.5x8 (36), 3.5x11 (44), 3.5x13 (42), 4.0x6 (46)). The patient was extremely satisfied with the esthetic and functional outcome of the treatment.

Prashanti Eachempati in 2013 advocated the use of implant supported over denture for the resorbed mandibular ridge. New set of complete dentures were fabricated for the patient during the healing phase. The dentures were relieved over the attachments to allow passive seating of the denture without contact on the metal housing but full contact with the ridge circumferentially. The dentures were inserted and the patient guided into occlusion and instructed to lightly occlude. There was marked improvement in the retention and stability of the dentures. Abdulgani Azzaldeen *et al.* in 2015 advocated the use of implant supported overdenture in cases of severely resorbed mandibular ridges. The patient existing denture was relined with temporary relining material for further use existing denture. The implants cover screws were removed and healing abutment were screwed into the implant body. The patient was delighted with the adequate retention, stability, comfort, and function of the mandibular implant retained overdenture to his complete satisfaction denture and attachments were clean. Farhan Durrani in 2015 advocated the use of implant retained overdenture in cases of severely resorbed mandibular ridges. The prosthesis designed was bar and clip with a low profile type 2 attachment. Dr. Kirti Jajoo & Dr. Anjali Bhojar in 2015 advocated the use of two implant supported overdenture. The mandibular denture was fabricated in the and relieved from the area where the implants were placed so that it could be seated passively over the implants. Denture was lined by a soft reliner (Coe-Soft Reliner, Dentsply) in the area of implant so that patient can use prosthesis immediately after surgery. After fishing and polishing of denture containing the metal encapsulators, occlusal equilibration was done intraorally. Amit Khattak in 2015 advocated the use of custom bar in implant supported overdenture while connecting the two implants the support from two implants. Adequate primary stability was present on placement of the implants. A customized framework of copings and bar was fabricated over the analogues in self-cure acrylic resin. The dentures were tried and minor adjustments done. They were then finished and polished. The follow up protocol included routine check-ups every month. The patient was extremely satisfied with her new set of dentures.

Treatment of resorbed mandibular ridges is the area where the expertise in implants have benefited the most. The alveolar bone comes and goes with the teeth, but the basal bone remains stable, with its cortices. These are potentially strong anchors. This cortical anchorage is the key of this basal osseointegrated implants philosophy. In BOI system, instead of being limited by the vertical dimension of the ridge the horizontal dimension is utilized. This helps in keeping the blood supply of the bone intact, and become a skeletal endosseal implant fixture. But if we look at the complications, basal implants require masticatory pattern to be very precisely balanced i.e. bilateral balanced occlusion is necessary. As the entry is closer of the area of scarring, it can give an easy gateway for the penetration of infection. But again the immediate loading of the implant has played the most added advantage of basal implants. As we see the evolution of implants in the past three decades, it has come to notice that the though the basal implantology has opened a completely different avenue for restoring resorbed mandibular ridges, but the clinical set up has shown some resistance towards adapting to this new philosophy. Crestal implantology has come up with different designs and modifications to adapt to the requirements of the patient and it has been more readily put into practice by the clinician.

## Conclusion

In the era of evolution making choices is a difficult thing with the wide variety of given options. Even though the basal implants represent a very good alternative to the crestal implants, the research on the previously mentioned type is still inadequate. With the limited literature present on the basal implants and the complications suspected, still the crestal implants represent a safer option in rehabilitation of the resorbed mandibular ridges. Placement of basal implants requires an extensive exposure of the surgical site this makes it even more prone to the surgical complications. Endosseous implants gives the delayed loading concept which if studied in details has proven better for the osseointegration of the implant with the surrounding bone. The post - operative complications when compared with endosseous implants have had an upper hand. Considering the ease of operation and the given research material it will be appropriate to conclude that endosseous dental implants have been more readily opted by the clinicians while restoring resorbed mandibular ridges.

## Limitations

Due to inadequate research on the basal implants, it will be a biased conclusion when comparing endosseous and basal dental implants. Because of the language barrier many reported articles which are not in English could not be included. As the accessibility to many of the international journals is hampered there is a limitation in excess to the text available on those sites. As the sample size was small due to the clinical setup the results can be biased. As the authors were not reachable in terms of absence of full text, including those articles was not possible.

## Recommendations

As the difference in philosophies have lead to favouring of one theory universally, there should be more research on the concept of basal osseointegrated implants.

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