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Systematic Review Article

Survival Rate and Marginal Bone Loss in Screwable Basal Implants- A Systematic Review

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Abstract:

Introduction: The conventional dental implant treatment of severely atrophic jaws involves many surgical procedures to provide sufficient bone support involving guided bone regeneration or sinus floor elevation. Screwable basal implants are introduced as an alternate treatment modality because they fix the cortical and basal bone, providing excellent primary stability, especially in damaged ridges. Although it is increasingly used in the clinic, the available data on implant survival rate and marginal bone loss are still conflicting. Therefore, the present systematic review aims to analyze the existing evidences on survival rate and marginal bone loss of screwable basal implants.

Method: The systematic review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria. Literature search was done utilizing database of PubMed and Google Scholar which gave 193 records and 38 papers were included in the research. A quantitative meta-analysis could not be performed due to variability in research design, implant systems, follow-up durations and outcome measures.

Results: The survival rate of screwable basal implants analysed from the included studies varied from 87% to 100%. The implant-weighted mean survival rate was around 96.1% at a mean follow-up of 34.6 months with an average of 326 implants per trial. A few studies indicated minor bone loss with mean value of 1.15 mm after one year. The research claimed positive clinical results, although the data were from observational studies, case series, and case reports.

Conclusion: Screwable basal implants have shown great survival rate and may be considered as a realistic therapeutic option for the rehabilitation of severely atrophic ridges, particularly when further augmentation operations are required for traditional implants. However, the overall quality of the research is affected by limitations owing to the frequency of low-level study design and absence of randomized controlled trials. Moreover, well-designed prospective studies with a long-term follow-up are needed to optimize the efficacy, safety, and clinical indications of screwable basal implants.

Keywords: Atrophic jaws, dental implants, screwable basal implants, survival rate, marginal bone loss, PRISMA.

1. INTRODUCTION

Dental implants are considered among the most successful modalities for restoration of partially and completely edentulous patients. The long-term success of these implants depends on availability of sufficient alveolar bone density and volume. Therefore, patients suffering from moderate to severe alveolar ridge atrophy often require other surgical procedures, such as sinus floor elevation, alveolar nerve repositioning, guided bone regeneration or alveolar bone grafting. Although these procedures facilitate implant placement, they increase complications in surgery and lengthen treatment time resulting in increased cost of treatment and patient morbidity [1, 2].

To overcome these limitations, alternative implant designs have been introduced for patients with severely resorbed ridges; among these are basal implants. They are also known as strategic implants, biocortical implants or smooth-surface

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implants, have gained attention as they are designed to engage the cortical and basal bone rather than solely relying on alveolar ridges as a supporting medium [1, 2]. As these implants require anchorage from cortical and basal bone to achieve stability, basal implants have been used as a potential alternative treatment to conventional implant therapy in situations where extensive augmentation procedures would otherwise be necessary [1, 3, 4].

Unlike conventional implants, which primarily rely on osseointegration within the alveolar bone, basal implants obtain initial stability through cortical anchorage and osseofixation. This biomechanical concept has facilitated the development of immediate loading protocols, often allowing prosthetic rehabilitation within a short period following implant placements [1-5]. In the basal implant literature, the long-term biological response around these implants has been described as osseoadaptation, reflecting continuous bone remodeling and adaptation under functional loading conditions [1, 6].

Among the various basal implant systems, screwable basal implants are one of the most frequently reported designs and include Compression Screw Design (KOS) implant, Bi-Cortical Screw Design (BCS) implants, and Compression + Bi-Cortical Screw Design (KOS Plus) implants and Basal Osseo Integration (BOI)/ Trans Osseous (TOI)/ Lateral Implant Designs (Fig. **1**). Basal implant systems may also be classified according to their mode of insertion as axially inserted implants or laterally inserted implants (Fig. **2**).

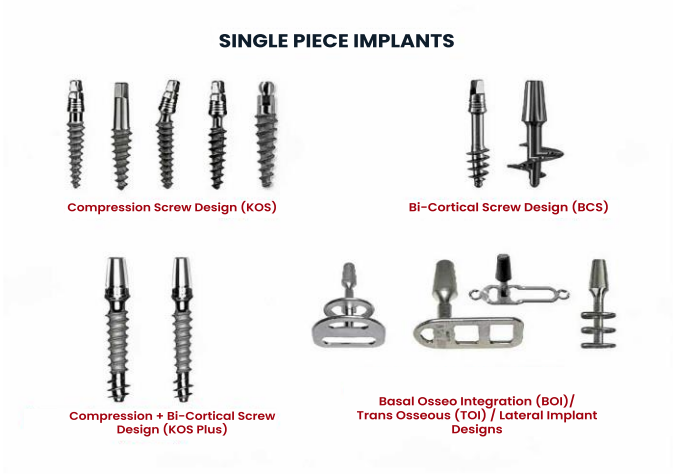

Fig. (1). Types of basal implants.

Several clinical studies have reported high survival rates for screwable basal implants; however, reported outcomes vary across study designs, follow-up durations, and patient populations [1, 7]. Furthermore, available evidence consists predominantly of case reports, case series, and observational studies, with limited high-level evidence and relatively few randomized controlled trials. Consequently, the overall strength of evidence supporting the use of screwable basal implants remains uncertain.

Therefore, a comprehensive synthesis of the available evidence regarding the survival rate and marginal bone loss associated with screwable basal implants is warranted. The aim of this systematic review was to evaluate the survival rate and marginal bone loss of screwable basal implants and to critically assess the current evidence supporting their clinical use.

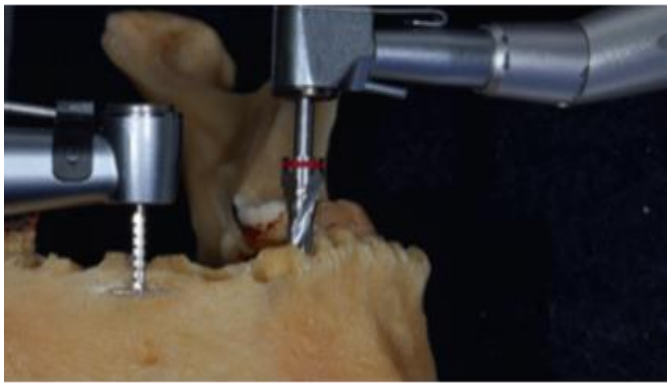

Fig. (2). Lateral osteotomy *vs.* axial osteotomy.

2. MATERIALS AND METHODS

2.1. Study design

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards.

2.2. Data Sources and Research Strategy

A comprehensive literature search was performed on PubMed, Google Scholar and other sites specified in Table **1** using boolean operators AND, OR and NOT for relevant research published from 2013 to 2024. The data search was performed between 21 April 2024 and 20 August 2024.

2.3. Eligibility Criteria

The present review included studies evaluating screwable/ screw-form basal implants in partial or complete edentulous patients, while studies evaluating disk-form basal implants, plate-form basal implants, zygomatic screw implants, tubero-pterygoid (pterygoid) implants, or conventional crestal implants were excluded.

2.4. Selection of Studies

A literature search yielded a total of 193 records, of which 88 studies were from Google Scholar, 69 studies from PubMed and 36 studies from other sources. Duplicates were deleted and 132 entries were checked for titles and abstracts only, with a further 56 items discarded. The remaining 76 papers were read in full text and 38 studies were discarded because they did not match the inclusion criteria. The evaluation comprised 38 papers in the end (Fig. **3**).

2.5. Data Extraction

Data from the 38 papers included in the systematic review were collected using a standardized data collecting form. The data retrieved included: research design, sample size, country, number of implants, follow-up period, marginal bone loss, implant survival rate and other clinical outcomes.

2.6. Risk of Bias Evaluation

The quality of the cohort and comparative studies was rated using the Newcastle-Ottawa Scale (NOS). Case reports and case series were descriptively reviewed since formal procedures for assessment of risk of bias are not explicitly developed for this research type.

2.7. Data integration

Because of the high heterogeneity of the included papers, a quantitative meta-analysis was not possible. Moreover, the patient demographics, implant systems, outcome measures, and length of follow-ups varied, not allowing for meaningful comparisons of the data provided. Therefore, the results were summarized descriptively.

Survival rates and marginal bone loss were summarized and the implant-number weighted mean survival rate was determined using the number of implants reported in each trial.

3. RESULTS

A total of 193 records were identified through database and manual searches. Following duplicate removal and eligibility assessment, 38 studies were included in the review (Fig. **3**).

The included studies consisted of 10 prospective studies, 4 retrospective cohort studies, 2 comparative studies, 1 randomized controlled trial, 2 observational studies, 14 case reports and 5 case series. The characteristics of the included studies are summarized in Table **1**. These studies were conducted from several countries, with the largest proportion conducted in India (52%), followed by Sudan (21%) and Bulgaria (8%). The geographic distribution of the included studies is presented in Fig. (**4**). The follow-up period ranged from 6 to 96 months, with a mean follow-up duration of 34.6 months. The average number of implants per study was 326. The reported survival rate of screwable basal implants ranged from 87% to 100%. The implant-number weighted mean survival rate across the included studies was approximately 96.1%.

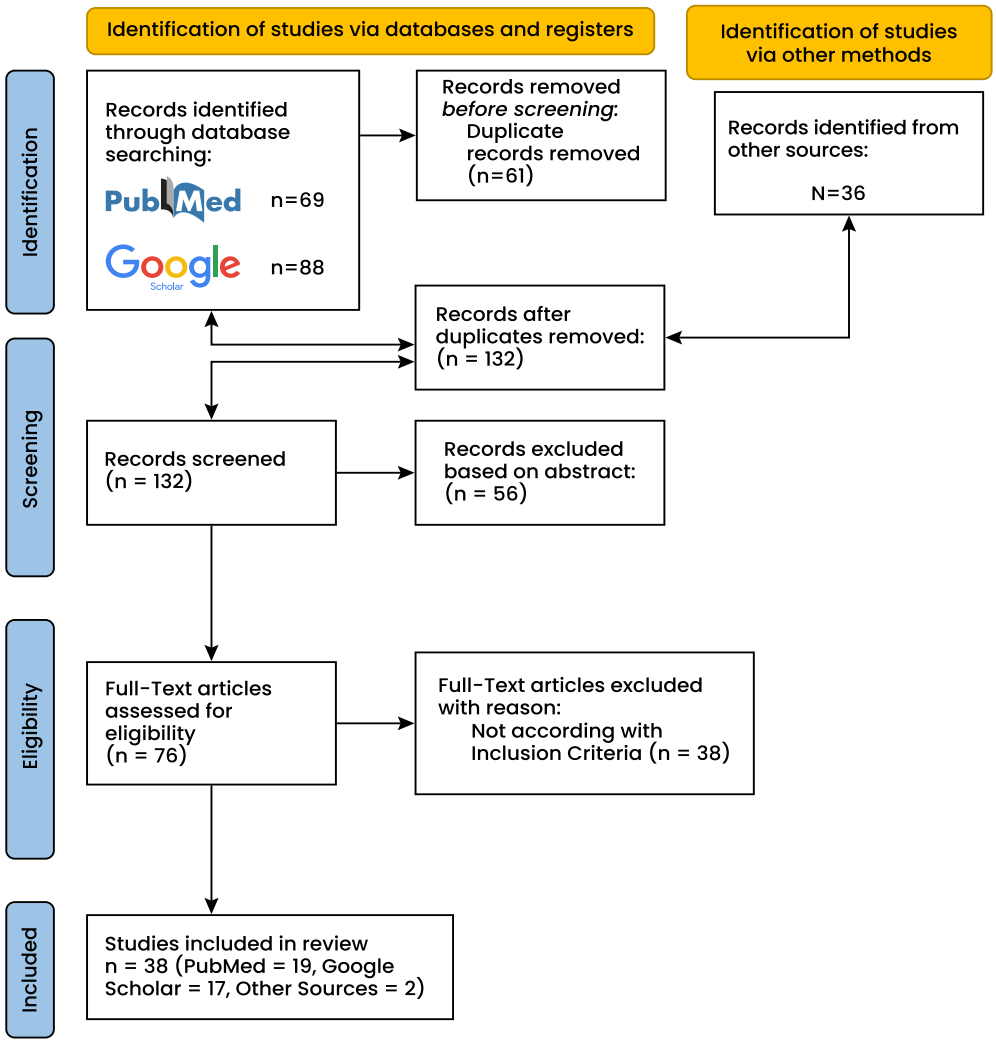

Fig. (3). PRISMA flow diagram of the literature search and study selection process for the systematic review.

Table 1. Characteristics of included studies.

No.	Authors & Year	Type of Research	Journal	Country	No. of Implants	Follow-Up	Findings (Survival Rate and/or MBL)
1	Gosai *et al*. [3]	Single Center Prospective Study	Journal of Maxillofacial and Oral Surgery	India	125	20.07(± 4.23) Months	96.8 % The mean bone loss after one year was 0.33 mm (E) and -1.57 mm (ES).
2	Lazarov. [5]	Prospective Cohort Study	Annals of Maxillofacial Surgery	Bulgaria	217	66 Months	99.54%
3	Patel *et al*. [6]	Prospective Cohort Study	Annals of Maxillofacial Surgery	India	157	1 Year	97.50%
4	Mitra *et al*. [7]	Observational Study	Cureus	India	30	6 Months	1.06 mm of MBL after 6 Months
5	Anuradha *et al*. [8]	Prospective Clinical Study	Journal of Family Medicine and Primary Care	India	57	6 Months	100%
6	Abdali *et al*. [10]	Retrospective Assessment	Journal of Oral Research	Iraq	156	1 Year	100% and MBL was 0.64 mm
7	Száva *et al*. [11]	Prospective Cohort Study	Journal of Interdisciplinary Medicine	Romania	56	12 Months	100% MBL after 6 months = 1.59 mm and after 12 months = 2.05 mm.
8	Aleksandar Lazarov, [12]	Prospective Cohort Study	Annals of Maxillofacial Surgery	Bulgaria	1169	57 Months	100%
9	Pałka and Lazarov. [14]	Retrospective Cohort Study	Annals of Maxillofacial Surgery	Bulgaria	1019	Mean follow-up time: 22.2 ± 7.3 Months	99%
10	Mundt *et al*. [15]	Randomized Controlled Clinical Trial	Clinical Oral Investigations	Germany	232	3 Year	99% in the mandible versus 87% in the maxilla
11	Gaur *et al*. [21]	Case Report	BAOJ Dentistry	India	8	6 Months	100%
12	Awadalkreem *et al*. [22]	Case Report	International Journal of Surgery Case Reports	Sudan	6	5 Years	100%

13	Awadalkreem *et al*. [23]	Case Series	International Journal of Surgery Case Reports	Sudan	18	5,6,7 Years	100%
14	Jani *et al*. [24]	Prospective Cohort Study	Journal of Dental and Medical Sciences	India	2193	90 Months	>90%
15	Ahmad *et al*. [25]	Retrospective Cohort Study	Journal of Contemporary Dental Practice	Sudan	172	Mean = 3.76 Years (2-5 Years)	100%
16	Awadalkreem *et al*. [26]	Prospective Observational Study	The Journal of Contemporary Dental Practice	Sudan	174	18 Months	100%
17	Oleg *et al*. [27]	A Multi-Center Retrospective Cohort Clinical Study	Journal of Evolution of Medical and Dental Sciences	Russia	4570	24 Months	95.70%
18	Ahmad *et al*. [28]	Case Report	International Journal of Surgery Case Reports	Sudan	14	3 Years	100%
19	Gaur *et al*. [29]	Case Report	International Journal of Surgery Case Reports	India	18	4 Years	100%
20	Ahmad *et al*. [30]	Case Report	International Journal of Surgery Case Reports	Sudan	15	7 Years	100%
21	Chaturvedi *et al*. [31]	Case Series	National Research Denticon	India	50	6 Months	100%
22	Osman *et al*. [32]	Case Report	Case Reports in Dentistry	Sudan	4	4 Years	100%
23	Hassan *et al*. [33]	Case Report	Cureus	India	1	5 Years	100%
24	Inbarajan *et al*. [34]	Case Report	Cureus	India	3	5 Years	100%
25	Ihde *et al*. [35]	Case Report	Case Reports in Dentistry	Germany	2	12 Months	100%
26	Nelluri *et al*. [36]	Prospective Clinical Study	Contemporary Clinical Dentistry	India	90	3 Years	93% in anterior maxilla and 91% in posterior mandible. D3 bone showed more MBL than D2 bone.
27	Radhakrishnan *et al*. [37]	Case Report	Journal of Pharmacy and BioAllied Sciences	India	3	3 Years	100%

28	Manjunath *et al*. [38]	Case Report	International Journal of Applied Dental Sciences	India	20	6 Months	100%
29	Awadalkreem *et al*. [39]	Observational Study	Annals of Maxillofacial Surgery	Sudan	45	18 Months	100%
30	Khazaal & Ismael. [40]	Comparative Study	The Iraqi Postgraduate Medical Journal	Iraq	158	6 Months	98.11%
31	Morgano. [41]	Case Series	Journal of Oral Implantology	Italy	13	8 Years	100%
32	Nikhil *et al*. [42]	Prospective Cohort Study	Global Journal of Medical Research: J Dentistry & Otolaryngology	India	15	6 Months	100%
33	Sharma *et al*. [43]	Case Series	Indian Journal of Dental Sciences	India	N/A (30 Patients)	9 Months	100%
34	Gaur *et al*. [44]	Prospective Cohort Study	Dentistry Journal	India	471	22 Months	~99%
35	Chakranarayan *et al*. [45]	Longitudinal Observational Study	IP Annals of Prosthodontics and Restorative Dentistry	India	265	1 Year	97.84%
36	Gaur *et al*. [46]	Case Report	Annals of Maxillofacial Surgery	India	9	3 Years	100%
37	Garg *et al*. [47]	Comparative Study	Annals of Maxillofacial Surgery	India	52 (34 Endoosseous, 18 Basal)	3 Years	100%
38	Gangadhar *et al*. [48]	Case Series	Journal of Orthodontic Sciences	India	473	1 Year	100%

Most of the available evidence was derived from observational studies, case series, and case reports, whereas only one randomized controlled trial was identified.

3.1. Marginal Bone Loss

Marginal bone loss data were reported in a limited number of studies. Abdali *et al.* [10] reported a mean marginal bone loss of 0.64 mm after one year. Száva *et al.* [11] reported marginal bone loss values of 1.59 mm after 6 months and 2.05 mm after 12 months. Gosai *et al.* [3] reported marginal bone loss of 0.33 mm in healed edentulous ridges and 1.57 mm in fresh extraction sockets after one year. Another study by Mitra *et al.* [7], the mean crestal bone level decreased from 10.76 mm before surgery to 9.7 mm after 6 months (Fig. **5**).

Based on the studies reporting marginal bone loss outcomes, the arithmetic mean marginal bone loss was 1.15 mm after one year. However, this value should be interpreted with caution because it was derived from a limited number of heterogeneous studies and does not represent a pooled estimate or a weighted mean value.

4. DISCUSSION

This systematic study aimed to analyze the survival rate and marginal bone loss of screwable basal implants. Survival rates varied from 87% to 100%. The implant-number weighted mean survival rate was around 96.1% The average follow-up time of the included studies was 34.6 months. These data indicate that screwable basal implants may provide good therapeutic results in several clinical scenarios including rehabilitation of severely atrophic ridges.

The weighted mean survival rate found in the current study seems to be similar to survival rates reported in the literature for both conventional and basal implant treatment. Basal implants have been described as having excellent clinical performance in previous evaluations, especially in patients with weakened alveolar ridges and in instances when traditional augmentation

operations may be avoided [8, 9]. Moreover, clinical trials have shown stable peri-implant bone levels and little marginal bone loss surrounding basal implants with rapid loading procedures [10, 11]. Moreover, rapid loading of basal implants has been linked with good patient satisfaction and predictable clinical performance in healed and new extraction sockets [12, 13-15].

In the case of conventional implant treatment, a systematic review and meta-analysis showed an estimated survival percentage of around 96.4% (95% CI: 95.2-97.5%) during a 10-year period [16]. Similar survival rates were found in immediate implant placement protocols, around 90%–95%, [17, 20] whereas implants implanted in ideal clinical settings included guided bone regeneration treatments, with survival rates between 97% and 100% [18, 19]. Direct comparison between screwable basal implants and conventional implants has to be interpreted cautiously owing to variations in implant design, research methodology, patient demographic, follow-up length and outcome evaluation methodologies.

Most of the studies included in the current review indicated good survival rates for screwable basal implants. For example, Jani *et al.* [24] reported a survival rate of more than 90% after 4 years in 291 patients with 2193 basal implants. Similarly, Lazarov reported total survival up to 57 months follow-up of 95.7% [5, 12, 14]. Gosai *et al.* [3] reported a 96.8% survival rate in patients treated with bicortical basal implants under rapid loading procedures. Taken together, these results imply that positive outcomes are possible with the right therapeutic practices.

The data on marginal bone loss were provided by just a few research. The average marginal bone loss recorded in these investigations was 1.15 mm at the end of one year. This estimate should be used with caution, since it is based on a limited number of diverse research, and is not a pooled estimate. However, the values found are frequently within the limits that are clinically appropriate for implant treatment [10, 11]. However, the overall level of evidence remains low with the majority of research including observational cohort studies, case reports and case series with just one RCT found for the study. Moreover, there was a large variation across trials for implant design, patient characteristics, loading techniques, outcome measures and follow up time. Therefore, a quantitative meta-analysis was not practicable, and the results of the research should be interpreted with care.

PATIENT-CENTERED OUTCOMES

The research included in this evaluation seldom addressed patient reported outcomes. While several studies have indicated improvements in masticatory performance, esthetics and patient satisfaction after treatment with screwable basal implants, the data is still limited and varied. Future studies should include standardized patient-reported outcome measures to properly assess the effect of screwable basal implants on quality of life and functional results.

LIMITATIONS OF THE CURRENT STUDY

Despite these results, the overall quality of the research is restricted with most studies consisting of case reports, case series and observational cohort studies [22, 28] and just one randomized controlled trial reported by Mundt *et al.* [15]. In addition, there was significant variation across trials regarding implant design, patient selection, loading methods, outcome evaluation, and follow-up time. These factors prevented direct comparison of studies and prohibited quantitative meta-analysis [14]. More well-designed prospective research and randomized controlled trials are required to enhance the present evidence base.

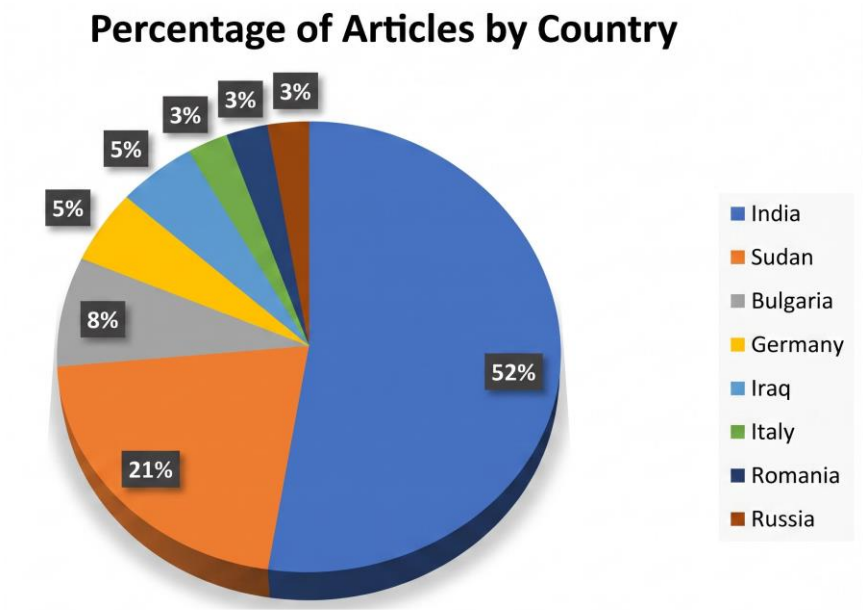

Fig. (4). Percentage of articles included in the review by country.

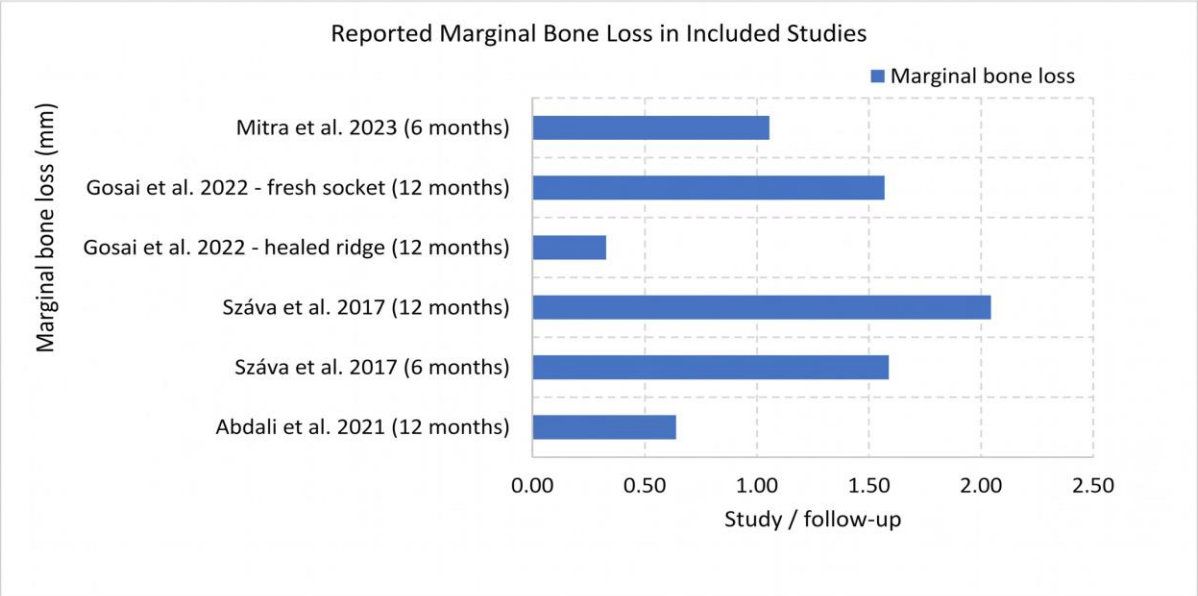

Fig. (5). Marginal bone loss.

CONCLUSION

The survival rates for screwable basal implants were reported between 87% and 100% within the limits of the available data, with an implant number weighted mean survival rate of around 96.1%. Within the limitations of the existing research, screwable basal implants may be a feasible therapy option for selected individuals, especially in the cases with severe ridge atrophy. However, the present data is mostly case reports, case series and observational studies with only very little high-level evidence. no conclusive conclusion about the superiority of screwable basal implants against standard implant treatment can be formed. Future well-designed prospective studies and randomized controlled trials are needed to further examine the long-term survival, marginal bone loss, patient-reported outcomes and clinical indications of screwable basal implants.

LIST OF ABBREVIATIONS

BCS	=	Bi-Cortical Screw Design
BOI	=	Basal Osseo Integration
KOS	=	Compression Screw Design
KOS Plus	=	Compression + Bi-Cortical Screw Design implants
NOS	=	Newcastle-Ottawa Scale

AUTHORS' CONTRIBUTIONS

O.E. was responsible for conceptualizing the study design and finalization of the manuscript. A.R.A. was responsible for data collection, analysis and interpretation as well as manuscript writing.

REPORTING GUIDELINES

PRISMA guidelines were followed in this study.

FUNDING

None

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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None

DECLARATION OF AI

The authors used ChatGPT for manuscript editing and take responsibility for the published content.

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