Mini implants for definitive prosthodontic treatment: A systematic review

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Statement of problem. Mini implants are commonly used in orthodontics and for interim prosthodontic treatment, but evidence for their use in definitive prosthodontic treatment is not clear.

Purpose. This systematic review evaluated the mini-implant literature to analyze short-term (1 to 5 years), medium-term (5 to 10 years), and long-term (beyond 10 years) survival rates when used for definitive prosthodontic treatment.

Material and methods. An electronic search of the English language literature for articles published between January 1974 and May 2012 was performed by using PubMed and Cochrane databases with predetermined inclusion criteria. Key terms included in the search were mini dental implants, narrow diameter implants, reduced diameter implants, small diameter implants, transitional implants, interim implants, and provisional implants. After a systematic filtering process, the selected articles were subjected to a detailed review, and the data collected were used to calculate the 1-year interval survival rate (ISR) and the cumulative survival rate (CSR).

Results. The electronic database search yielded 1807 titles. By scrutinizing the titles and abstracts with inclusion and exclusion criteria, the researchers identified 9 studies of mini implants for definitive prosthodontic treatment. Of the studies identified, 1 was a randomized controlled trial, 2 were prospective studies, and 6 were retrospective studies. The majority of mini implants were placed by using a flapless surgical technique in the mandibular anterior region to support an overdenture. The 1st year ISR was 94.7% and the CSR over a 9-year period, primarily attributed to data from 1 study, was 92.2%. Most implants were immediately loaded and almost all implant failures occurred during the first year after implant placement.

Conclusions. For short-term survival, the first year ISR of 94.7% of mini dental implants appears encouraging, but the true 1-year survival rate is unknown, as the minimum follow-up period reported for several implants was less than a year. Insufficient information about failures after the first year makes it difficult to draw conclusions about the medium-term survival of these implants. Currently, there is no evidence for the long-term survival of mini implants. (J Prosthet Dent 2013;109:156-164)

Clinical Implications

Currently there is limited evidence regarding the medium-term survival and no evidence regarding the long-term survival of mini implants used for definitive prosthodontic treatment.

The surgical placement of dental implants can be challenging when the quantity and/or quality of available bone is insufficient to accommodate the width of the implant.[1-9] Solutions for patients with narrow alveolar ridges seeking dental implants include the following: 1) residual ridge augmentation or guided bone regeneration procedures followed by the placement of standard diameter implants; 2) vertical distraction osteogenesis; 3) ridge split or ridge expansion procedures; and 4) the use of reduced diameter implants, with or without bone grafting procedures. However, reduced diameter implants may not be narrow enough to be accommodated by an atrophic alveolar ridge, or the patient may not opt for additional surgical procedures or may not be a viable candidate for these alternative options.

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The literature is not clear regarding the terminology associated with reduced diameter implants. The terms mini implants, narrow diameter implants, and small diameter implants have been used interchangeably. Additionally, the use of terms such as provisional implants, transitional implants, and orthodontic implants has further added to the confusion. However, the Glossary of Oral and Maxillofacial Implants[10] (GOMI) has defined the term mini implant as an "implant fabricated of the same biocompatible materials as other implants but of smaller dimensions. Implants can be made as one piece to include an abutment designed for support and/or retention of a provisional or definitive prosthesis." No diameter threshold is specified for these implants. A provisional implant is defined as an "endosseous implant made to smaller dimensional specifications with narrow widths. Can be used for a defined period of time (i.e. immediate, temporary, and/or transitional) or to support a transitional prosthesis."[10] An orthodontic anchorage implant is defined as an "endosseous dental implant commonly used as anchorage for orthodontic tooth movement. Osseointegrated interface is exceptionally well suited for use as an orthodontic anchor because of its ankylotic nature. Implant may be miniature or standard sized."[10] However, in spite of these multiple definitions, no consensus on the definition of reduced diameter im-

TABLE 1. Summary of differences between mini dental implants and narrow diameter implants

	Mini Dental Implant	Narrow/Small Diameter Implant
1	Defined as "implant fabricated of the same biocompatible materials as other implants but of smaller dimensions. Implant can be made as one piece to include an abutment designed for support and/or retention of a provisional or definitive prosthesis".[10] Most commonly reported in literature as implants with diameter ranging from 1.8 mm to 2.9 mm.	No consensus on definition in literature. Most commonly reported as implants that are fabricated from same biocompatible materials as other dental implants with diameter equal to, or greater than, 3 mm.
2	Historically used for interim purposes such as orthodontic treatment and interim fixed and removable prosthodontic treatment.	Historically used for definitive fixed prosthodontic treatment in mandibular anterior region and maxillary lateral incisor region.
3	Implants are commonly available as 1-piece design with fused implant-abutment complex.	Implants are commonly available as 2-piece design where abutment is connected to implant separately.
4	Intended for immediate load of prosthesis.	Intended for immediate or delayed load of prosthesis
5	Commonly placed by flapless surgical approach.	Commonly placed by surgically raising a mucoperiosteal flap.
6	Due to flapless surgery placement, these implants are rarely associated with bone grafting procedures.	May involve bone grafting procedures when mucoperiosteal flap is raised.
7	Not always placed in narrow alveolar ridge. Indication is also dictated primarily by low cost and other patient related factors.	Usually placed in narrow ridges. Indication is primarily dictated by width of ridge and interdental space available.
8	In edentulous arches, multiple implants (>2) are usually needed due to narrow diameter, unpredictability of survival and lack of current scientific understanding.	In edentulous arches, finances and available bone primarily dictate number of implants.
9	Insertion torque for implant placement is significantly lower compared to standard implants.	Insertion torque for implant placement is comparable to standard dental implants.
10	Significantly less expensive than standard dental implants.	Cost is comparable to standard dental implants.
11	When used for orthodontic treatment, these implants can be placed at any stage of treatment.	When used for orthodontic treatment, implants should be placed strategically through careful treatment planning.
12	When used for prosthodontic treatment, tangible treatment outcomes include immediate satisfaction for patient.	When used for prosthodontic treatment, tangible treatment outcome for patients is not always immediate.

plants exists in the literature.

Reduced diameter implants were first introduced in the literature as the "miniplant" by Barber and Seckinger in 1994.[11] This implant was of 2.9 mm diameter with an external connection. This study was followed by a report by Sendax,[12] who conceived of the ultra-small 1-piece implant with a diameter of 1.8 mm. The primary intention was to support an interim prosthesis, as it was expected these implants would be easily removed. However, it was noted that removal of these implants from the bone was difficult as they appeared to have osseointegrated.[2,13] Histologic studies later confirmed that bone appeared to be integrated to the surface of the ultra-small implant at the light microscopic level, and the bone appeared to be mature and healthy.[14] Sendax[12] also stated that these implants could serve as a low-cost alternative implant in edentulous ridges for definitive prosthodontic treatment. Since then, numerous implant manufacturers have produced reduced diameter implants with claims that they are indicated not only for narrow ridges but also as a low-cost alternative for definitive fixed and removable prosthodontic treatment. The reason for the low cost of mini implants in comparison to standard diameter implants remains unclear. The United States Food and Drug Administration (FDA) has approved the use of mini implants in the human jawbone for interim and long-term prosthodontic treatment.[15]

Given the confusion between mini implants and narrow diameter implants, many implant manufacturers have portrayed the dimensions of these 2 implants interchangeably to satisfy manufacturing and marketing requirements. However, significant differences exist between mini implants and narrow diameter implants (Table 1). The primary advantages of using mini implants for definitive prosthodontic treatment are: 1) low cost[7]; 2) ability to be placed in narrow or wide ridges[1,2,6]; 3) simplified treatment procedures without a steep learning curve for the clinician[6]; 4) almost always placed through a flapless surgical procedure, which is known to decrease postsurgical discomfort and morbidity for patients[1,3,5,6-8]; and 5) the majority are designed as a 1-piece implant with the ability to immediately load the prosthesis and provide tangible treatment benefit to the patient in a single clinical visit.[1-3,5-8,16] The primary disadvantages of mini implants for definitive prosthodontic treatment are as follows: 1) the need for multiple implants because of the unpredictability and lack of current scientific guidelines and understanding; 2) the limited scientific evidence about long-term survival; 3) the potential for fracture of the implant during placement[6]; 4) the fact that lack of parallelism between implants is less forgiving because of the 1-piece design; 5) the reduction in resistance to occlusal loading, similar to narrow diameter implants[17]; and 6) other disadvantages attributable to flapless surgery (when used) such as lack of bone visibility, inability to irrigate the bone, and contraindications in situations requiring alveoloplasty to gain prosthetic space.[18] Despite these disadvantages, the need for mini implants will continue to grow, especially among edentulous patients because of 1) an increase in the need for complete dentures[19]; 2) the increased cost of standard implants[2,7]; 3) access-to-care issues, especially among economically disadvantaged patients and patients indicated for maxillofacial prostheses; 4) medically compromised patients who may not be candidates for traditional surgical procedures or ridge augmentation procedures[2,7]; and 5) an increased interest in implant dentistry among general dentists.[20] Therefore, there is a need to review the current evidence and synthesize the available clinical data on the survival of mini implants for definitive prosthodontic treatment.

The purpose of this study was to systematically review the current literature on mini implants and analyze their short-term, medium-term, and long-term survival rates when used exclusively for definitive prosthodontic treatment. In this study, mini implants were defined according to the GOMI in conjunction with a diameter threshold of 3 mm.

MATERIAL AND METHODS

An independent electronic search of the English language literature was conducted by 2 investigators, using PubMed and Cochrane Library databases. Exact search terms were mini dental implants, narrow diameter implants, reduced diameter implants, small diameter implants, transitional implants, interim implants, and provisional implants. The period searched was from January 1974 to April 2012. The inclusion criteria were as follows: 1) any English language article in a peer-reviewed scientific journal; 2) any article on humans involving mini dental implants, narrow diameter implants, reduced diameter implants, small diameter implants, transitional implants, interim implants, or provisional implants; 3) any article describing a clinical study involving these implants only for prosthodontic treatment purposes. The exclusion criteria were as follows: 1) articles that did not clarify mini implant description as defined by GOMI; 2) articles that described implants equal to or greater than 3 mm in diameter; 3) articles that described the use of implants solely for purposes of interim/provisional/transitional prosthodontic treatment; 4) technique/review articles; 5) case reports or case series reporting fewer than 3 participants; 6) clinical data or participants that were redundantly reported in other included articles; and 7) articles that did not allow mining of quantitative data.

The electronic search was conducted in 3 stages in a hierarchical order. During stage 1, a record of titles was acquired from the 2 electronic databases, and each investigator independently analyzed relevant titles based on the predetermined inclusion criteria. Both investigators

independently applied the exclusion criteria, and any discrepancy was resolved by discussion. In situations of uncertainty, the disputed article was included for contemplation in the abstract stage. At stage 2, both investigators separately screened the abstracts of all selected titles. Again, any disagreement between the authors was discussed, and, in uncertain situations, the abstract was included for the subsequent stage of full-text analysis. At stage 3, the investigators studied all full text articles that were included. Thereafter, final exclusion criteria were applied, and the final list of articles was reviewed in depth for extraction of qualitative and quantitative data. In this systematic review, short-term survival was defined as the presence of mini implants in function after 1 to 5 years of implant placement; medium-term survival was defined as the presence of mini implants in function after 5 to 10 years of implant placement; and long-term survival was defined as the presence of mini implants in function after 10 years or more of implant placement. Implant failure was defined as the absence or loss of the mini implant. The quantitative data extracted from the final list of articles could only be used for the computation of the interval survival rate (ISR) during various time intervals, and the cumulative survival rate (CSR) over a multiyear period. The ISR is an element that represents the proportion of surviving items in a group during a specific time interval only.[21,22] The cumulative survival rate represents the proportion of items existing at the beginning of a time interval which survives until the end of the interval being studied.[10,21,22] A life table survival analysis for the total number of implants surviving over a multiyear period was performed to study these 2 elements.[22]

TABLE II. Exclusion of 13 full-text articles based on various criteria

Exclusion Criteria Applied	Article Excluded
Articles that did not clarify implant descriptions as defined by GOMI and described implants equal to or greater than 3 mm in diameter	Arisan et al[26] (2010) Franco et al[27] (2009)
Articles describing use of mini implants solely for purposes of interim prosthodontic treatment	Ahn et al[16] (2004)
Review/technique article with no associated clinical data	Barber et al[11] (1994) Sendax[12] (1996)
Case report/series with fewer than 3 patients	Misch et al[28] (2007)
Patients or data present in other included articles	Jofre et al[29] (2010) Jofre et al[30] (2010) Vigolo et al[31] (2004) Shatkin et al[32] (2003)
Article description that did not allow extraction of quantitative data	Anitua et al[13] (2010) LaBarre et al[33] (2008) Bulard et al[34] (2005)

RESULTS

The search from both electronic databases resulted in a total of 1807 titles, out of which only 69 abstracts were applicable to the study. Application of the predetermined exclusion criteria led to a total of 22 articles for full text analysis. Further scrutiny resulted in the elimination of 13 full-text articles (Table II). This resulted in a total of 9 studies, from which qualitative and quantitative data were extracted for analysis (Table III and Table IV). Of the 9 studies, 1 was a randomized controlled trial,[3] 2 were prospective studies,[1,4] and 6 were retrospective studies.[2,5-9] Most studies reported the use of mini implants to stabilize complete dentures because of narrow alveolar ridges in the anterior mandibular region. The few studies that reported the use of mini implants for other regions of the mandible and maxilla used them for single crowns.[2,6-9] Only 1 study reported data on the use of mini implants to support maxillary complete dentures.[6] Most studies (6/9) used a flapless surgical technique for implant placement, while 2 of the 3 remaining studies described used full thickness flaps and mini implants for single crowns. Almost all studies used roughened/treated surface implants, ranging in length from 8.5 mm to 18 mm. The diameter range was 1.8 mm to 2.9 mm, with the most commonly reported mini implants being 1.8 mm and 2.4 mm in diameter. Almost all studies (7/9) described the use of 1-piece implants, which were immediately loaded. The 2 studies that described the use of 2-piece implants were subjected to delayed loading.[4,9] Only 1 study described complications during surgical placement, with 20 of the 2514 (0.8%) implants fracturing during placement.[6] No complications other than implant failures were reported in any of the other studies. Risk factors for implant failures reported in a few studies were the use of a removable prosthesis in the posterior maxillary region, smoking, the presence of atrophic ridges, and implant overload.[3,6]

A total of 798 patients from all 9 studies received mini implants. The sample size ranged from 10 participants to 531 participants per study. A total of 3095 mini implants were placed with a range of 11 implants[2] to 2514 implants.[6] The implant follow-up period was different for different studies, with the highest being 8.7 years after implant surgery.[4] Only 2 studies provided follow-up data for a 5-year period.[4,9] Furthermore, in ev-

TABLE III. Qualitative data of the final 9 included studies on mini implants for definitive prosthodontic treatment

Referennce	Type of Study	Site of Implant Placement	Surgical Technique	Implant Company	Surface Type
Elsyad et al[1] (2011)	Prospective	Anterior mandible	Flapless	IMTEC Corporation Ardmore, Okla	Airborne-particle abraded acid-etched
Balaji et al[2] (2010)	Retrospective	Maxillary and Mandibular anterior and premolar regions	Full thickness flap	Hi-Tec Implants Herzlia, Israel	Integrated roughened surface
Jofre et al[3] (2010)	RCT	Anterior mandible	Flapless	IMTEC Corporation	Airborne-particle abraded acid-etched
Morneburg and Pröschel[4] (2008)	Prospective	Anterior mandible	Full thickness flap	Komet Dental Lemgo, Germany	Airborne-particle abraded coated with calcium phosphate
Cho et al[5] (2007)	Retrospective	Anterior mandible	Flapless	Atlas; Dentatus AB Spango, Sweden	Airborne-particle abraded with aluminium oxide grit
Shatkin et al[6] (2007)	Retrospective	Maxillary and Mandibular anterior and premolar regions	Flapless	IMTEC Corporation	Airborne-particle abraded acid-etched
Griffitts et al[7] (2005)	Retrospective	Anterior mandible	Flapless	IMTEC Corporation	Airborne-particle abraded acid-etched
Mazor et al[8] (2004)	Retrospective	Maxillary and Mandibular anterior and premolar regions	Flapless	Hi-Tec Implants Herzlia, Israel	Integrated roughened surface
Vigolo et al[9] (2000)	Retrospective	Maxillary and Mandibular anterior and premolar regions	Full thickness flap	3i Implant Innovations Inc. Boston, Mass	Not reported

ery included study, for each follow-up period, different numbers of implants were reported (Fig. 1). A description of life table survival analysis or its equivalent was provided in only 3 studies.[1,3,4] Consequently, the authors extracted data from the remaining 6 studies in order to incorporate them in a combined life table survival analysis (Table V). Collective data from the 9 studies revealed a total of 170 implant failures over different time intervals. However, 161 of the failures, from all 9 studies, occurred within the first year after implant surgery. Therefore, the ISR was lowest for the first year interval at 94.7%. The CSR computed for a 9-year interval, primarily attributable to data reported by 1 study,[4] was 92.2%. Because of limited data and inconsistencies in reporting, no attempt was made to compare qualitative data and quantitative data or draw conclusions for implant survival rates of a 1-piece design versus a 2-piece design, the maxillary region versus the mandibular region, the anterior region versus the posterior region, short implants versus long implants, or immediately loaded versus delayed-loaded mini implants.

DISCUSSION

The goals of this systematic review were to analyze the short-term, medium-term, and long-term survival rate of mini implants when used exclusively for definitive prosthodontic treatment. However, because of limited data, it was not possible to analyze the medium-term or long-term survival of mini implants. It is interesting to note that, though mini implants were first introduced over 15 years ago, the number of published studies in prosthodontics/implant literature is limited. Furthermore, only 2 studies[4,9] reported a follow-up period of 5 years and beyond, and the sample sizes within most of the studies were relatively low. Additionally, there were no studies comparing mini implants with narrow diameter or standard dental implants for complete denture

TABLE III. (CONTINUED) Qualitative data of the final 9 included studies on mini implants for definitive prosthodontic treatment

Implant Length	Implant Diameter	Type of Implant Design	Type of Prosthesis	Type of Loading
12 mm to 18 mm	1.8 mm	One-piece	Complete denture on nonsplinted abutments	Immediate load
13 mm	2.4 mm	One-piece	Single crowns	Immediate load
15 mm	1.8 mm	One-piece	Complete denture on nonsplinted abutments and splinted abutments	Immediate load
9 mm, 12 mm and 15 mm	2.5 mm	Two-piece	Complete denture on nonsplinted abutments	Delayed loading
Not reported	2.4 mm	One-piece	Complete denture on nonsplinted abutments	Immediate load
10-18 mm	1.8 mm and 2.4 mm	One-piece	Complete denture on nonsplinted abutments, Single crowns and partial fixed dental prostheses	Immediate load
10-18 mm	1.8 mm	One-piece	Complete denture on nonsplinted abutments	Immediate load
13 mm	2.4 mm	One-piece	Single crowns	Immediate load
8.5 mm, 10 mm, 13 mm and 15 mm	2.9 mm	Two-piece	Single crowns	Delayed loading

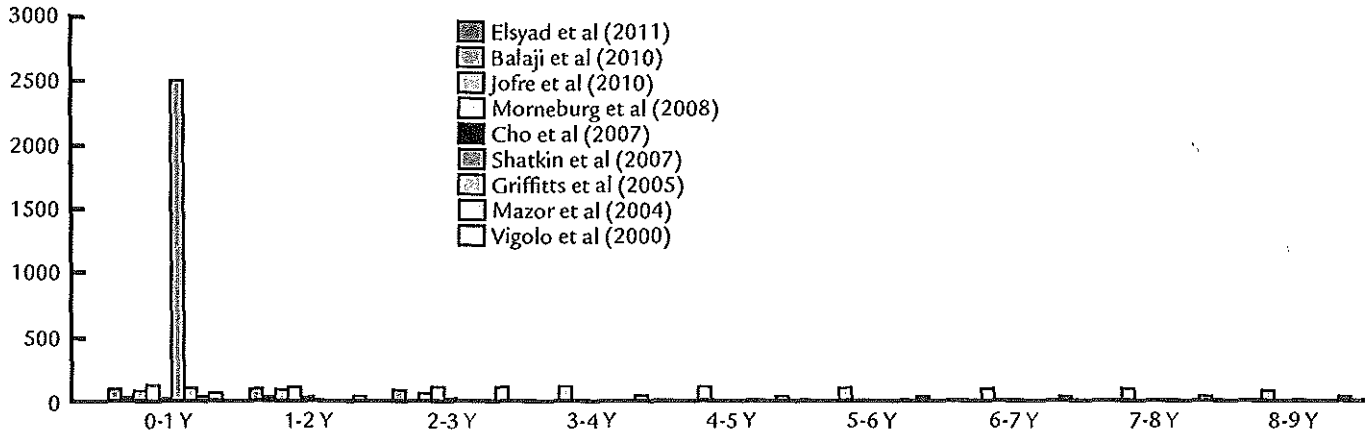
therapy and no studies describing the use of mini implants to support maxillofacial prostheses such as obturators. In contrast, a number of studies on the use of mini implants for orthodontic treatment were found.[23-25] Perhaps, this is because of the short time that mini implants are used in orthodontics; this facilitates the design of the study.

Of the 9 studies analyzed in this systematic review, 1 was a randomized controlled trial, 6 were retrospective studies, and 2 were prospective studies. The method of reporting on mini implant follow-up in various studies was variable and not amenable to data extraction. Various challenges in extracting quantitative data from the final 9 studies were as follows: 1) the majority of studies reported a broad follow-up period (between 1.1 and 8.7 years); 2) most studies did not report how many implants were followed during a specific time interval and did not clarify when the implant failures occurred; 3) most studies described follow-up periods of less than 3 years; 4) only 3 studies reported a life table survival analysis; 5) for most studies, the follow-up period of several implants was reported to be less than 12 months, suggesting that the 1-year true survival rate of numerous mini implants is unknown.

The application of the first 6 exclusion criteria listed in this systematic review was relatively uncomplicated.[26-28] However, 7 full text articles that were excluded because of redundant reporting that did not allow mining of quantitative data were scrutinized.[13,29-34] Before their exclusion, both investigators independently reanalyzed these articles and then discussed them in depth.[13,29-34] Three articles were excluded because they did not allow the extraction of quantitative data. Anitua et al[13] described 51 participants with 89 implants of 2 diameters (2.5 mm and 3 mm), and although the authors clarified that 30 of 31 implants of 2.5 mm diameter survived during a 3-year period, they

TABLE IV. Quantitative data of final 9 included studies on mini implants for definitive prosthodontic treatment

Study Name	Number of Participants	Total Implants in Study	Number of Failures during 1st Year	Number of Failures after 1st Year	Total Failures Reported in Study	Range of Follow-up in Years
Elsyad et al[1] (2011)	28	112	2	2	4	3 years
Balaji et al[2] (2010)	11	11	1	0	1	2 years for all implants
Jofre et al[3] (2010)	45	90	0	5	5	3 years
Morneburg and Pröschel[4] (2008)	67	134	4	2	6	3.3 -8.7 years
Cho et al[5] (2007)	10	34	2	0	2	1.1-3 years
Shatkin et al[6] (2007)	531	2514	145	0	145	Up to 5 years
Griffitts et al[7] (2005)	30	116	3	0	3	Not reported
Mazor et al[8] (2004)	32	32	1	0	1	Up to 5 years
Vigolo et al[9] (2000)	44	52	3	0	3	5 years for all implants



Bar graph showing number of mini implants in each included study at different time intervals [in years (Y)]. Note attrition of number of implants reported during each follow-up period. Also note that only 2 studies reported follow-up data beyond third-year interval.

did not report the timing of the failure. This precluded incorporation of these data into the life table analysis, and the article was excluded. LaBarre et al[34] described a retrospective experience with 626 mini implants in a university where most implants were placed by senior dental students. Of the 626 implants, 46 mini implants were lost, yielding an overall success rate of 92.6%. Again, the authors did not report when these implant failures occurred, and the article had to be excluded. Bulard and Vance[35] described a multiple clinic study with 1029 mini implants with a broad range of follow-up (5 months to 8 years). Though the authors stated that approximately 600 mini implants were in function for a minimum of 2 years, these data were not explicit or clarified. Unfortunately, no information about how many implants were followed for each time period up to 8 years was given, or how many failures occurred during each period. Because of these inconsistencies and insufficient data, this study was also excluded.

The process of quantitative data extraction was challenging, and the previously discussed difficulties prohibited the calculation of the short-term, medium-term, and long-term survival rates of mini implants, as initially intended by the investigators. Therefore, existing data only allowed

TABLE V. Life-table survival analysis showing cumulative survival rate of mini implants for all 9 studies combined

Time Interval in Years	Number of Mini Implants in Interval	Number of Failures in Interval	Number of implants Surviving in Interval	Interval Survival Rate (ISR)	Cumulative Survival Rate (CSR)
0-1	3095	161	2934	94.7	94.7
1-2	416	2	414	99.5	94.2
2-3	384	5	381	99.2	93.4
3-4*	178	1	177	99.4	92.8
4-5*	175	1	174	99.4	92.2
5-6*	170	0	170	100	92.2
6-7*	110	0	110	100	92.2
7-8*	106	0	106	100	92.2
8-9*	98	0	98	100	92.2

*Data beyond 3rd year interval were reported in only 2 studies.[4,9]

for the calculation of the ISR and CSR, and because data beyond the third-year interval were only provided by 2 studies,[4,9] no additional statistics were performed using the life table survival analysis. It is important to be aware that the first year ISR of 94.7% does not signify the 1-year true survival rate of mini implants, because not all mini implants had a minimum follow-up period of 1-year.

In this systematic review, every article relevant to narrow diameter and small diameter implants was originally considered as though they were mini implants in order to increase the number of articles that could be included. The GOMI definition of mini implants and a diameter threshold of 3 mm was applied accordingly.[10] This resulted in the initial inclusion of many articles which were later excluded after in-depth analysis. Future investigators should be explicit in differentiating narrow diameter implants/small diameter implants from mini implants, and all ambiguities should be resolved. As no previous clinical studies or consensus reports have differentiated between these 2 types of implants, the authors of this systematic review chose a diameter threshold of 3 mm in conjunction with the definition of mini implant from the GOMI. The authors believe that an implant with a diameter of 3 mm or greater is best described as a narrow diameter implant, which is significantly different from a mini implant as tabulated in this article. The adoption of the 3-mm diameter threshold and the GOMI definition is suggested for future studies on mini implants.

CONCLUSION

Within the limitations of this systematic review, the following conclusions were drawn:

1. The evidence for short-term survival of mini implants when used exclusively for definitive prosthodontic treatment is encouraging, with a first year interval survival rate of 94.7%. However, the follow-up period of several implants was reported to be less than 12 months, suggesting that the 1-year true survival rate of numerous mini implants remains unknown.

2. Limited evidence for the medium-term survival (only 1 study) and no evidence for the long-term survival of mini implants when used for definitive prosthodontic treatment is available.

3. Current terminology in the literature does not differentiate between mini implants and narrow diameter implants. For accurate and prospective comparison of treatment outcomes, the suggested diameter threshold of 3 mm or greater should be used in conjunction with definitions from GOMI.

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