SYSTEMATIC REVIEW

Connecting of Implant to Natural Teeth – A Systematic Review

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Abstract

Background:. Implants luted to natural teeth are thought to be an effective kind of therapy when there is anatomical restriction on implant area or when an implant fails to osseointegrate, However, research has shown that in FPDs that are based on luting of implants and teeth, there is a noticeable marginal loss of bone and possibility of loss of osseointegration, particularly in FPDs that resemble real teeth. Evaluations of the long-term outcomes of FPDs based on luting of natural teeth with implants are scarce.

Aim: To conduct a thorough assessment of the literature on the frequency of physiological and technical issues in addition to frequency of long term survival of implants luted to natural tooth during the course of more than five years of monitoring.

Methods and Materials: Pubmed, Scopus, Embase, Web of Science, Ovid, Global Health, PsycINFO, etc. were searched thoroughly using the combination of phrases " dental implant luted to natural tooth, survival rates, FPDs based on natural tooth luted to dental implants, success rates, survival rates with Extensive searches were performed for all publications using inclusion and exclusion criteria.in the range of June 28th, 2018 and February 28th, 2024. Every study was assessed properly and following data were extracted from each study: authors,total duration of exposure (months) ,number of failures of dental implants,approximated five year survival rate (percentage),approximated ten year survival rate (percentage), approximated failure rate (per 100 years) (percentage)

Results: For this comprehensive assessment, 19 articles were chosen. The overall 10 year survival rate ranged between 64.74% to 100%, while it ranged between 75.75% and 100% for 10 year survival rate. The percentage of implant failure varied from 9.53 % to 0 percent.After five years and ten years, the average anticipated implant failure rate was 1.89 percent and 1.97 percent. respectively. 1.6 percent of all implants on average were found to have lost material before they could be functionally loaded. 7.4 percent of the implants lost their functionality while they were in use. After five years and ten years, respectively, tooth luted implant supported FPDs had a projected rate of failure of 1.08 percent and 2.51 percent.

Conclusion: On comparing results with only implant supported FPDS, the failure rate was greater in implant luted tooth supported FPDS. However, in clinical situations (i.e., decreased bone volume, particularly in posterior edentulous locations where only a single implant can be put) when the luting of a dental implant with natural tooth to support an FPD appears unavoidable, a solid connection should be made by the two different abutments. Ultimately, additional carefully planned longitudinal studies are needed to evaluate the clinical effectiveness of FPDs with combined tooth and implant support.

Keywords: Implant, natural tooth, luting.

Introduction

The repair of lost dentition can be accomplished by a variety of prosthetic procedures. The rehabilitation strategy is determined by the quantity, configuration, and condition of remaining teeth (such as periodontal condition and tooth morphology), as well as by the patient's preferences, expenses, and bone density that supports dental implants.[1-3]Implants luted to teeth are thought to be an effective kind of therapy. When there is anatomical restriction on implant area or when an implant fails to osseointegrate, this procedure is taken into consideration. Luting a natural tooth with an implant, improved mechanoreception, and additional assistance for the dentition's overall load are some benefits of implant-tooth based prosthesis.[4-6] Furthermore, using implants to join teeth increases the restorative dentist's treatment options, lowers the cost of replacing teeth, and eliminates the need for cantilevers. However, the fundamental issue was that it was thought that because of the differences in their patterns of movement, implants would be susceptible to greater stresses when attached to teeth.[5-8] Numerous investigations documented marginal loss of bone or implant osseointegration failure. The literature has documented a number of problems, including caries, mechanical failure, tooth intrusion, and elimination of occlusal contacts.[9-12] In recent years, osseointegrated dental implants have gained acceptance as a treatment alternative for partially edentulous patients seeking to rebuild their dentitions in both an aesthetically pleasing and functionally sound manner.[13-16] Apart from a fixed partial denture (FPD) that is supported only by implants, prostheses that are attached from the tooth luted to the dental implant has also been suggested as a therapeutic option.[17-21] The luting of an implant and a natural tooth to support a fixed partial denture appears to be unavoidable in clinical situations with decreased volume of bone (particularly in edentulous areas of posterior region), where merely a single implant can be placed.[21-24] Numerous research works have detailed real-world scenarios in which FPDs are bolstered by luting between natural teeth and dental implants.These investigations suggested that implants and natural teeth might be connected in an FPD with a reasonably good prognosis.[25-29] These investigations did note, however, that one factor contributing to the Branemark implant system's effectiveness was its flexibility. However, research has shown that in FPDs that are based on luting of implants and teeth, there is a noticeable marginal loss of bone and possibility of loss of osseointegration, particularly in FPDs that resemble real teeth.[30-36] Evaluations of the long-term outcomes of FPDs based on luting of natural teeth with implants are scarce. This article's main goal is to conduct a thorough assessment of the literature on the frequency of physiological and technical issues in addition to frequency of long term survival of implants luted to natural tooth during the course of more than five years of monitoring.

Methods and Materials

Methods

This review was written according to the guidelines established by Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Not a single rule was broken, yet a more thorough search strategy did provide more relevant results. (figure1).

Sources of information and keywords used for search of literature

Pubmed, Scopus, Embase, Web of Science, Ovid, Global Health, PsycINFO, etc. were searched thoroughly using the combination of phrases " dental implant luted to natural tooth, survival rates, FPDs based on natural tooth luted to dental implants, success rates, survival rates with Extensive searches were performed for all publications using inclusion and exclusion criteria.in the range of June 28th, 2018 and February 28th, 2024.

Eligibility criteria for selection

Included were original studies, literature reviews, scientific communications, systematic reviews, letters to the editor, and many additional preprints addressing the following areas related to luting of dental implant with natural tooth

1. Long term survival of dental implants luted with natural tooth
2. Success rate of dental implants luted with natural tooth
3. Success of FPDs based on natural tooth luted with dental implants
4. Failures of dental implants luted with natural tooth
5. Failures of FPDs based on natural tooth luted with dental implants

Exclusion criteria were outlined as follows:

1. Publications discovered in newspapers, magazines, blogs, and other non-academic venues;
2. Written materials not in English;
3. Documents related to issues not included in the inclusion requirements
4. Publications not written for an academic audience

Reviewing process

Before being tasked with the screening activity, reviewers received training in both full-text evaluation and assessment of simply the abstracts. The test was executed in an abstract manner using the Rayyan

program. While one observer (AB) looked through all of the search results, three researchers (XX, HH, and JJ) independently reviewed 33.33 percent of the total hits twice. After reading the abstracts, the review committee got together to resolve their differences and create the final list of articles that needed to be evaluated in full. A full-text review was conducted using the Covidence program. Two independent reviewers, WW and YY, read the whole articles and rated them according to the criteria. When researchers weren't sure whether or not a certain method was employed in an article, they went straight to the authors to ask for clarification. Members of the panel and reviewers from the scientific committee reached consensus on the final list of articles to be considered for review.

Data Extraction

Every study was assessed properly and following data were extracted from each study

1. Authors
2. Total duration of Exposure (Months)
3. Number of Failures of dental implants
4. Approximated five Year Survival Rate (percentage)
5. Approximated ten Year Survival Rate (percentage)
6. Approximated Failure Rate (per 100 Years) (percentage)

PICO

P= Patients having dental implants luted to natural teeth
I= FPDs placed on dental implant luted to natural teeth
C= Controls having FPDs with two dental implants
O= Approximated ten Year Survival Rate,Number and percentage of failures of dental implants

Evaluation of risk of bias of the included studies

The effectiveness of the chosen studies was evaluated using the "risk of bias" technique developed by the Cochrane Collaboration. Each of the seven bias risk domains—random sequence generation, allocation concealment, participant and staff blinding, blinding of outcome assessment, incomplete outcome data, selective reporting, and other bias—was subjected to an individual critical examination. Each domain was categorised as having a low, unclear, or high risk of bias. Two independent researchers extracted the qualitative and quantitative data, evaluated the risk of bias, and extracted the information. Discussions amongst the evaluators were used to settle disagreements.

Results

Results of search of study

78 papers were discovered through a literature search using search criteria. There were 21 publications that were excluded because they were duplicates or similar. 57 different articles were first chosen. Following an examination of the titles and abstracts, 35 publications were removed. For 22 articles, full text management was done. Extra two papers were manually retrieved from references. There were 24 articles with full texts that could be read. 05 subpar articles were eliminated from the final evaluation. Finally, for this comprehensive assessment, 19 articles were chosen. (figure 1).

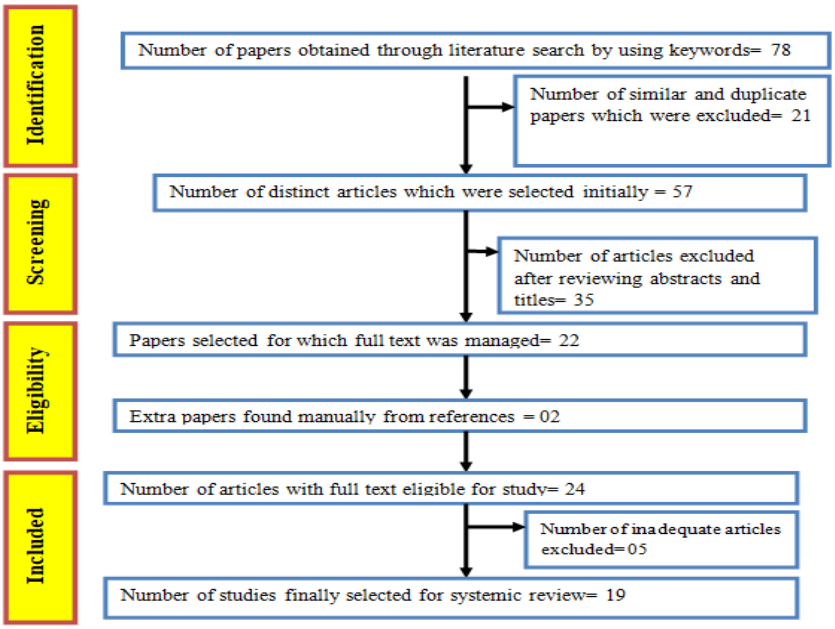

Figure 1: PRISMA flowchart to show selection of studies

Results of risk of bias assessment

Detailed results of risk of bias assessment have been shown in table 1. Some of the studies reviewed were found to have moderate risk of bias [2,3,18,21,23,25,26,28,29,32]. Few studies were found to have minimum risk of bias [1,27,18,22], while remaining studies had maximum risk of bias.

Table 1: Results of risk of bias assessments

Author year	Sequence generation	Allocation concealment	Blinding of participants, personnel	Blinding of outcome assessors	Incomplete Outcome data	Selective outcome reporting	Other sources of bias	Overall risk of bias
Akca and Cehreli [17]	+	-	+	+	+	+	+	-
Nickenig et al [18]	+	?	?	?	+	+	+	?
Block et al [21]	+	?	?	?	+	+	+	?
Mau et al [22]	+	+	+	+	+	+	+	+
Naert et al [23]	?	?	?	?	+	+	+	?
Kindberg et al [24]	+	-	+	+	+	+	+	-
Bra¨gger et al [25]	+	-	+	+	+	+	+	-
Hosny et al [26]	+	?	?	?	+	+	+	?
Olsson et al [29]	+	?	?	?	+	+	+	?
Koth et al [32]	+	?	?	?	+	+	+	?
Nickenig et al [18]	+	+	+	+	+	+	+	+
Bra¨gger et al [25]	+	?	?	?	+	+	+	?
Gunne et al [27]	+	+	+	+	+	+	+	+
Fartash and Arvidson [28]	?	?	?	?	+	+	+	?
Steflik et al [30]	+	-	+	+	+	+	+	-
Jemt et al [31]	+	-	+	+	+	+	+	-
Zafiropoulos GG et al [2]	+	?	?	?	+	+	+	?
Cordaro L et al [3]	+	?	?	?	+	+	+	?
Narde J et al [1]	+	+	+	+	+	+	+	+

Minimum Risk of Bias represented by +; Moderate Risk of Bias represented by ?; Maximum Risk of Bias represented by -

Results of Outcomes of implant luted to natural tooth

Zafiropoulos GG et al [2] evaluated 91 cases of implant luted to natural tooth for a duration of 11.8 years. There was failure of 1 implant (9.53%). The overall survival rate of implants on 10 year follow up was 90.47%. Akca and Cehreli [17] evaluated 64 cases of implant luted to natural tooth for a duration of 2.2 (2–2.5) years. There was failure of 0 implant (0%). The overall survival rate of implants on 5 year follow up was 100%. [Table 2] Block et al [21] evaluated 80 cases of implant luted to natural tooth for a duration of 5 years. There was failure of 1 implant (0.28%). The overall survival rate of implants on 5 year follow up was 98.61%. Mau et al [22] evaluated 297 cases of implant luted to natural tooth for a duration of 5 years. There was failure of 51 implant (4.59%). The overall survival rate of implants on 5 year follow up was 79.51%. Naert et al [23] evaluated 339 cases of implant luted to natural tooth for a duration of 6.5 (1.5–15) years. There was failure of 19 implant (0.93%). The overall survival rate of implants on 5 year follow up was 95.45%. Kindberg et al [24] evaluated 115 cases of implant luted to natural tooth for a duration of 5 (1–8.9) years. There was failure of 9 implant (2.09%). The overall survival rate of implants on 5 year follow up was 90.09%. Bra¨gger et al [25] evaluated 19 cases of implant luted to natural tooth for a duration of 5 years. There was failure of 1 implant (1.08%). The overall survival rate of implants on 5 year follow up was 90.09%. Gunne et al [27] evaluated 23 cases of implant luted to natural tooth for a duration of 10 years. There was failure of 2 implant (1.08%). The overall survival rate of implants on 10 year follow up was 89.81%. Fartash and Arvidson [28] evaluated 27 cases of implant luted to natural tooth for a duration of 10 years. There was failure of 0 implant (0%). The overall survival rate of implants on 10 year follow up was 100%. Steflik et al [30] evaluated 28 cases of implant luted to natural tooth for a duration of 10 years. There was failure of 9 implant (4.35%). The overall survival rate of implants on 10 year follow up was 64.74%. The overall 10 year survival rate ranged between 64.74% to 100%, while it ranged between 75.75% and 100% for 10 year survival rate. The percentage of implant failure varied from 9.53 % to 0 percent. After five years and ten years, the average anticipated implant failure rate was 1.89 percent and 1.97 percent. respectively. 1.6 percent of all implants on average were found to have lost material before they could be functionally loaded. 7.4 percent of the implants lost their functionality while they were in use. After five years and ten years, respectively, tooth luted implant supported FPDs had a projected rate of failure of 1.08 percent and 2.51 percent. The overall estimated percentage for loss of abutment following a 5-year monitoring was 2.53 percent for implants and 2.72 percent for teeth. The aggregate estimate of abutment loss after a ten-year period of monitoring was 1.98 percent for implants and 5.65 percent for teeth. During the monitoring periods, a statistically significant distinction was seen between the loss of implants and the loss of abutment teeth The predicted rate of intrusion following a 5-years follow-up duration varied between zero percent to 3.36 percent. In total FPDs, the incursion rate was estimated to be 1.07%. One study [21] looked at the impact on implants as well as abutment teeth that were nonrigidly or rigidly attached in tooth luted implant assisted FPD; intrusion was visible in sixty-six percent of nonrigid connections and forty-four percent of rigid connections.In a different investigation, out of thirty-six individuals with nonrigid connections, 3 showed signs of incursion. Lastly, incursion was only found in 9 out of 3096 locations with implant-tooth contacts in mixed FPDs that were studied in a prior study during the course of a period of surveillance that varied from three to fourteen years.

Table 2: Important features of studies included in the review

Authors	Total duration of Exposure (Months)	Total number of dental Implants	Average Follow-up (Range), years	Approximated Failure Rate (per 100 Years) (percentage)	Number of Failures of dental implants	Approximated ten Year Survival Rate (percentage)	Approximated five Year Survival Rate (percentage)
Akca and Cehreli [17]	128	64	2.2 (2–2.5)	0.00	0		100.00
Nickenig et al [18]	n.a	142	4.73 (2.2–8.3)	0	n.a.	–	–
Block et al [21]	357	80	5	0.28	1		98.61
Mau et al [22]	1112	297	5	4.59	51		79.51
Naert et al [23]	2040	339	6.5 (1.5–15)	0.93	19		95.45
Kindberg et	431	115	5 (1–	2.09	9		90.09

al [24]			8.9)				
Bra¨gger et al [25]	93	19	5	1.08	1		94.77
Hosny et al [26]	195	31	6.5 (1.3–14)	0.51	1		97.47
Olsson et al [29]	100	23	5	2.00	2		90.48
Koth et al [32]	108	28	5	5.56	6		75.75
Nickenig et al [18]	n.a.	459	6.7 (2.11–5.8)	–	3	–	
Bra¨gger et al [25]	198	22	10 (8–12)	2.53	5	77.68	
Gunne et al [27]	186	23	10	1.08	2	89.81	
Fartash and Arvidson [28]	270	27	10	0.00	0	100.00	
Steflik et al [30]	207	28	10	4.35	9	64.74	
Jemt et al [31]	(6–19)	43	n.r.	8	n.a.	–	–
Zafiropoulos GG et al [2]	141.6	91	11.8	9.53	1	90.47	
Cordaro L et al [3]	24-94	90	-	0.01	1	99.0	-
Narde J et al [1]	6-24	22	0.5-2	0.05	1		95.4

Discussion

The primary objective of the systematic review was to investigate the frequency of survival along with incidence of complications associated with tooth implantation into implants. Included were studies on the rate of survival and physiological and technical difficulties of FPDs supported by tooth luted with implants with an average follow-up duration of at least five years. This study comprised twenty studies that satisfied the inclusion criteria. This systematic review excluded, in overall studies that failed to provide precise details about the length of the trial, the kind of suprastructures, or the rates of survival or events. The overall 10 year survival rate ranged between 64.74% to 100%, while it ranged between 75.75% and 100% for 10 year survival rate. The percentage of implant failure varied from 9.53 % to 0 percent .After five years and ten years, the average anticipated implant failure rate was 1.89 percent and 1.97 percent. respectively.

1.6 percent of all implants were found to have lost material before they could be functionally loaded. 7.4 percent of the implants lost their functionality while they were in use. These findings are validated by earlier systematic reviews.[21-28]After five years and ten years, respectively, tooth luted implant supported FPDs had a projected rate of failure of 1.08 percent and 2.51 percent. Comparing implant-tooth assisted FPDs to only implant assisted FPDs alone, the predicted rate of failure at ten years was much higher for the FPDs. However the predicted rate of failure at 5 year duration was found similar in both implant tooth supported FPDS and only implant supported FPDs as previous systematic studies had shown comparable results. Regarding the ten-year outcome of FPDs based on luting of implants with teeth, this is an important experimental finding. [18-26]

Block et al [21] evaluated 80 cases of implant luted to natural tooth for a duration of 5 years. There was failure of 1 implant (0.28%). The overall survival rate of implants on 5 year follow up was 98.61%. Mau et al [22] evaluated 297 cases of implant luted to natural tooth for a duration of 5 years. There was failure of 51 implant (4.59%). The overall survival rate of implants on 5 year follow up was 79.51%.

To give definitive guidance on the long-term viability and failure probability of implant luted tooth assisted FPDs, however, further carefully planned controlled

clinical investigations of a similar kind must become accessible.

Fartash and Arvidson [28] evaluated 27 cases of implant luted to natural tooth for a duration of 10 years. There was failure of 0 implant (0%). The overall survival rate of implants on 10 year follow up was 100%. Steflik et al [30] evaluated 28 cases of implant luted to natural tooth for a duration of 10 years. There was failure of 9 implant (4.35%). The overall survival rate of implants on 10 year follow up was 64.74%. The overall 10 year survival rate ranged between 64.74% to 100%, while it ranged between 75.75% and 100% for 10 year survival rate. The percentage of implant failure varied from 9.53 % to 0 percent.

The overall estimated percentage for loss of abutment following a 5-year monitoring was 2.53 percent for implants and 2.72 percent for teeth. The aggregate estimate of abutment loss after a ten-year period of monitoring was 1.98 percent for implants and 5.65 percent for teeth. During the monitoring periods, a statistically significant distinction was seen between the loss of implants and the loss of abutment teeth. Therefore, we can hypothesize that the observed greater rates of failure of the abutment teeth are likely the cause of the shorter overall survival of combination of implant tooth supported FPDs.

For the prior cohorts, an estimated 11.7% of biologic problems were documented. Analogous estimated aggregate incidences of biologic problems were found in prior systematic evaluations on FPDs supported by an amalgam of teeth luted with implants. Bone loss may also occur by splinting implants to normal teeth because of the unequal load distribution.[24-32]

Then, it was determined that peri-implant bone is more vulnerable to damage from a sustained static strain than alveolar bone. It seems that the distribution of stress in the tooth-to-implant interface is significantly influenced by the periodontal ligament. Additionally, the frequency of technical issues was assessed.[15-25] Complications related to implant abutments were separated into two categories: screw breakage and screw loosening. In one study, 9 out of 276 screw-retained abutments were unfastened, and 3 screw or abutment fractures were found. In a different study, screw loosening was reported in 7 out of 72 screw-retained FPDs with a recurrence, but no screw or abutment breakage was visible.

Many prosthetic procedures can be used to restore lost dentition. The rehabilitation strategy is based on the number, arrangement, and state of the remaining teeth (including periodontal disease and tooth morphology), as well as the patient's preferences, costs, and bone density supporting dental implants.[21-24] Implants luted to teeth are considered an effective kind of therapy; this procedure is considered when there is anatomical restriction on implant area or when an implant fails to osseointegrate. Benefits of implant-tooth based prosthesis include enhanced mechano reception, more support for the dentition's overall load, and better usc.[25-29]

Intrusion of tooth phenomena was one possible issue with using implants and teeth to support FPDs. The systematic review contained six studies that provide details on incursion.[18, 21, 23, 26] The predicted rate of intrusion following a 5-years follow-up duration varied between zero percent to 3.36 percent. In total FPDs, the incursion rate was estimated to be 1.07%. One study [21] looked at the impact on implants as well as abutment teeth that were non-rigidly or rigidly attached in tooth luted implant assisted FPD; intrusion was visible in sixty-six percent of non-rigid connections and forty-four percent of rigid connections. In a different investigation, out of thirty-six individuals with non-rigid connections, 3 showed signs of incursion. Lastly, incursion was only found in 9 out of 3096 locations with implant-tooth contacts in mixed FPDs that were studied in a prior study [24] during the course of a period of surveillance that varied from three to fourteen years. Rigid connection breaches or slippage were linked to all nine instances. This makes it evident that nonrigid connections are the primary means by which abutment teeth intrusion in integrated tooth luted implant based FPDs is identified.

Conclusions

The overall 10 year survival rate ranged between 64.74% to 100%, while it ranged between 75.75% and 100% for 10 year survival rate. The percentage of implant failure varied from 9.53 % to 0 percent .After five years and ten years, the average anticipated implant failure rate was 1.89 percent and 1.97 percent. respectively. On comparing results with only implant supported FPDS, the failure rate was greater in implant luted tooth supported FPDS. However, in clinical situations (i.e., decreased bone volume, particularly in posterior edentulous locations where only a single implant can be put) when the luting of a dental implant with natural tooth to support an FPD appears unavoidable, a solid connection should be made by the two different abutments. Ultimately, additional carefully planned longitudinal studies are needed to evaluate the clinical effectiveness of FPDs with combined tooth and implant support.

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