

Esposito M, Worthington HV, Coulthard P, and Thomsen P. Maintaining and re-establishing health around osseointegrated oral implants: a Cochrane systemic review comparing the efficacy of various treatment. *Periodontology* 2000 2003;3:204-12.

Purpose: The aim of the present study was to conduct a systematic review to assess which are the most effective interventions to maintain or to re-establish health around osseointegrated oral implants.

Materials and Methods: *Outcome measures:* plaque, marginal bleeding, probing pocket depth, attachment level, radiographic marginal bone level, implant failure, side effects, cost.

Search strategy for identification of RCTs (randomized controlled clinical trials): the search included electronic databases and hand-search.

Study selection, quality assessment and data extraction: The quality assessment of the included trials was undertaken independently and in duplicate by two reviewers using specially designed data extraction forms, recording year of publication, country of origin and source of study funding, demographic characteristics, details on the type of intervention, details of the outcomes reported, including method of assessment and time intervals, means and standard deviation was used to summarize the data.

Description of studies: Of the nine eligible trials, four were excluded and of the five included studies three were conducted in USA, one Netherlands and one in New Zealand. All trials were testing the effectiveness of methods for maintaining oral health around peri-implant tissues.

Findings and Conclusion: For the five trials included, the results were based on 127 patients with no implant failures.

Powered versus manual toothbrushing: including 36 patients at 6 weeks there was no significant difference in mean plaque scores.

Sonic versus manual toothbrushing: 31 patients in a 12 week data reported that, there was no statistically differences for plaque or probing pocket depth. Comparison of the number of participants who did not find toothbrushing easy was also not significant.

Antiseptic mouthwashes: (Listerine versus placebo) after 3 months statistically significantly less plaque and marginal bleeding were found with Listerine. However, the Listerine group had statistically significantly higher mean probing pocket depth scores. This study include 10 patients in each group, and demonstrated a reduction of 54% in plaque and 34% in marginal bleeding using Listerine compared to placebo.

Subgingival irrigation: (chlorexidine irrigation versus chlorexidine mouthwash) at 3 months, the group using chlorexidine irrigation had statistically significantly lower mean plaque scores than the group using chlorexidine mouthwash, the results were based only on 24 patients.

Phosphoric etching gel versus mechanical debridement: after 5 months there was no evidence of a difference between the treatment groups for plaque or probing pocket depth. When the treatment was administered for the first time, 9/16 patients reported slight (7 patients) to moderate pain (2 patients) at the side subjected to etching gel treatment compared to none in the debridement group. These findings are based on short follow-up periods and there is no reliable evidence for long-term maintenance, there is so far no reliable evidence for preferring one therapeutic regimen over another.

Eckert ES, Choi YG, Sánchez AR, Koka S. Comparison of Dental Implant Systems: Quality of Clinical Evidence and Prediction of 5-year Survival. Int. J. Oral Maxillofac Implants 2005;20:406-415. (79 refs.)

Purpose: The purpose of this study was to evaluate the quality of current evidence of clinical performance provided by 6 dental implant manufacturers (Astra Tech, Centerpulse, Friadent, Implant Innovations, ITI Straumann, and Nobel Biocare). Implant survival percentages from the 6 different companies was also evaluated from literature provided by the manufacturers.

Materials and Methods: The six implant manufacturers, chosen to participate in the study, were selected based on their participation in the ADA implant certification program or because of their reputation as a major supplier of dental implants in the United States. A letter was sent to the companies requesting 10 references each that validated the manufacturer's implant system in a variety of clinical applications including restoration of full arches, partially edentulous arches, and single tooth replacement. The articles were gathered and, following initial reviewer calibration, distributed to the four authors. Each reviewer read each article and provided a "level of evidence" rating for each article as described by (Eckert et al 2003).

Level of evidence	Type of study
1	Individual randomized controlled trials (with narrow CI)
2	Individual cohort study
3	Individual case-control, cross-sectional, or ecological studies
4	Case report or case series
5	Expert opinion without explicit critical appraisal or based on physiology, bench research, or "first principles"

Using data extracted from articles with 5 or more years of clinical data, the time of service required to achieve full ADA certification, computations were made to establish compiled tables for each of the applicable implant systems. Ninety-five percent confidence intervals were calculated.

Findings: A total of 69 references were provided by 5 companies (Friadent did not respond to requests for literature). A total of 53 articles provided information from clinical trials with 30 of these articles demonstrating results from case reports. Thirteen articles provided expert opinion without associated data, while 11 articles used comparison groups with or without randomization, placing 9 articles in the level 2 comparative cohort group and 2 articles in the level 1 group. Three implant manufacturers, Implant innovations, Nobel Biocare, and Straumann, provided most of the high-confidence (level 1 or 2) evidence. Only Nobel Biocare and Straumann provided high-level evidence for time periods of 5 or more years.

Manufacturer	Level	No. of studies	No. of Implants	Upper CI (%)	Known surviving implants (%)	Lower CI (%)
Astra Tech	2	4	773	99	98	96
Brånemark	7	4	2142	98	96	93
	1	2				
Steri Oss	2	4	944	98	96	92
Paragon	1	4	435	97	94	91
Centerpulse Spline	1	4	113	100*	99	97
Straumann	1	2	2359	98	95	93
Implant Innovations	2	4	632	100*	98	94
Weighted average of data pooled from all manufacturers	1-4	17	7398	98	96	93

*Upper CI was limited to 100%, although calculation may have demonstrated a higher value.

The 5 year survival rate of 96% was observed for a total of 7,398 implants.

Conclusion: Three fold: 1) No obvious differences in implant survival were observed when comparing implant systems, 2) The level of evidence supporting implant therapy is generally achieved

through case series rather than higher-level comparative cohort or controlled clinical trials, 3) Five-year weighted average implant survival extracted from 17 studies with a total of 7,398 implants showed a 96% survival, thereby exceeding the ADA standards for certification.

Doyle SL, Hodges JS, Pesun IJ. Retrospective cross sectional comparison of initial nonsurgical endodontic treatment and single-tooth implants. J Endod 2006;32:822-27.
(37 refs.)

Purpose: To compare retrospectively the outcomes of single tooth implant restorations with matched teeth receiving initial nonsurgical root canal treatment and restorations.

Material and Methods: Data were obtained from patient records. Single tooth restored implants with 1 year recall or those that had an untoward event before restoration were selected. For each implant, a matched endodontically treated tooth was selected. Implants were categorized as successful if radiographic and clinical data demonstrated that the implant is functional and present in the mouth with no signs of peri-implant radiolucency or implant mobility, as surviving if present in the mouth with subsequent post-treatment intervention or adjunctive procedures and as a failure if the implant was removed or planned for removal. Endodontically treated teeth were categorized as successful if the teeth were still present without any apical periodontitis or symptoms, as surviving if present in the mouth but had uncertain healing, or those that had post-treatment intervention, and as a failure if the tooth had to be extracted. Data was grouped into 4 groups: maxillary anterior, Mandibular anterior, maxillary posterior and mandibular posterior. Data were subjected to statistical analysis.

Findings and Conclusions:

- The number of failures for both the implant and endodontic group was similar, but the implant group had fewer successes and more cases of surviving with intervention compared to the endodontic group.
- Implants tended to fail sooner than the endodontic group.
- The difference in the endodontic and implant group did not depend on the location of the implant.
- Implants tend to have a longer time-to- function.

Haffajee AD, Torresyap G, Socransky SS. Clinical changes following four different periodontal therapies for the treatment of chronic periodontitis: 1-year results. J Clin Periodontol 2007;34:243-53. (43 refs.)

Purpose: To compare clinical changes occurring in chronic periodontitis subjects receiving SRP alone or with systemically administered azithromycin (AZ), metronidazole (MET) or a sub-anti-microbial dose of doxycycline (SDD).

Materials and Methods: In this randomized, single-blinded study, 90 healthy subjects with at least eight sites with PD>4mm were randomized to one of four treatment groups: SRP alone or combined with systemically administered AZ 500 mg once daily for 3 days or MET 250 mg tid for 14 days or 20 mg doxycycline (SDD, Periostat) bid for 12 weeks at the first SRP visit. At each monitoring visit (baseline, 3, 6 and 12 mo), overt gingivitis, BOP, suppuration, probing PD, probing AL were measured at six sites per tooth at all teeth excluding third molars. The PD and AL measurements were repeated at each visit. In addition all subjects received maintenance SRP at the three post-therapy monitoring visits. Data was analyzed.

Results:

- *Subject retention:* 67 of 98 subjects had clinical data for all four visits.
- *Patient compliance:* Compliance with taking the medication was determined by pill counts. 24/25 subjects completed the course of AZ. 16/24 subjects assigned to the MET group took the medication for at least 12/14 days. 75% of subjects receiving SDD took 95% of the tablets.
- *Teeth lost during the study:* A total of 7 teeth were extracted during the course of the study: two in one subject in the AZ group, one tooth in three subjects in the MET group and one tooth in two subjects in the SDD group.
- *Adverse events:* Two subjects in the AZ group, one in MET group and two in SDD group reported adverse events.
- *Pre-treatment characteristics:* No statistically significant differences among groups at baseline with exception of % of sites with suppuration, which was the highest in the SDD group.
- *Post-treatment characteristics:* There were statistically significant improvements over time for most parameters, irrespective of treatment group, with the greatest improvements between baseline and 3 months post-therapy. Subjects receiving the adjunctive agents exhibited greater clinical improvement than the subjects receiving SRP only particularly noticeable for PD and AL. There was an increase in mean PD and an increase in the mean AL in the SDD group that occurred after 3 months, at which point they ceased taking the medication.
- *AL/PD changes:* All treatment groups showed statistically significant reductions in mean PD and AL over time. Subjects in AZ or MET group showed greater mean PD reduction and AL gains post-therapy (6, 12 mo) compared with SDD or SRP groups.
- *LOA:* 16.6% in MET and 15% in SDD group showed mean LOA. A larger proportion of subjects in the AZ and SRP (39%) groups exhibited LOA.
- *Gain of attachment:* The increase in the mean percentage of sites showing attachment gain >2mm post-therapy was statistically significant in the AZ(5.3%) and MET(3.5%) groups. All groups exhibited a greater percentage of sites gaining attachment than losing attachment >2mm. However, the difference at 12 months was the smallest in the SRP group (1.48 vs. 0.76%).
- *Baseline PD (BPD) changes:* There was a reduction in PD in all treatment groups for each BPD category (<4, 4-6, >6mm), with the least reduction at shallow sites and the greatest reduction at the deep sites. AZ and MET has the best responses for PD reduction and AL gain.

Conclusions: The study demonstrated that periodontal therapy in general does provide clinical benefits and that adjunctive systemically administered antibiotics do provide a clinical benefit over SRP alone, particularly at initially deeper periodontal pockets. It also showed that not all subjects receiving a specific treatment responded clinically in the same fashion, indicating the importance of determining factors that impact treatment outcome so that the most appropriate therapy can be provided to individual subjects.

AC: Very misleading heading. Choice of antibiotics was surprising and so were the results. However, even with so many numbers, they fail to show the baseline characteristics well.

Das Neves FD, Fones D, Bernardes SR, et al. Short implants- an analysis of longitudinal studies. INT J ORAL MAXILLOFAC IMPLANTS 2006;21:86-93. (34 refs.)

Purpose: To evaluate and gather data from published articles on the use of short implants and their clinical success.

Materials and Methods: MEDLINE search using the words “dental implants and length and clinical” between the years of 1980 and 2004. The analysis was for Branemark System-compatible implants and included studies not listed in the initial MEDLINE search but which were cited by studies found. Data of interest for this study were: total number of short implants placed and lost (7mm, 8.5mm, or 10mm), time of implant failure (before or after prosthesis placement), and main risk factors related to implant failure.

Findings: A total of 16,344 implants were placed. 786 (4.8%) failed and were removed. Of the implants placed that were 7mm long and 3.75mm wide (1,894), 184 (9.7%) were lost. When implants of the same length with a diameter of 4mm were placed, the failure rate decreased to 7.5%. Of the 786 failures, approximately 45% occurred after loading. If the first year of loading was considered, the failure rate increased to 63.2%. When risk factors were reported, the maxillary posterior was most commonly implicated due to its poor bone quality.

Conclusions: Findings in this study lead to the following conclusions:

- short implants ≤ 7 mm should be considered a risk factor
- bone quality seemed to be an important risk factor when using short implants
- therapeutic success reported for 7mmX3.75mm implants (90.3%) provides support for the use of this implant design

Leonhardt A, Dahlen G, Renvert S. Five year clinical microbiological and radiological outcome following treatment of peri-implantitis in man. J Periodontol 2003; 74:1415-1422.

Purpose: To evaluate the longterm outcome of a combined surgical and antimicrobial treatment of peri-implantitis lesions in humans.

Materials and Methods: 9 subjects (4 men and 5 women) with a mean age of 67.7 years, who received 44 titanium implants and having one or more implant with peri-implantitis were selected for this study. All individuals were systemically healthy and had not been using any antibiotics during the 2 months preceding the baseline examination. 5 of the 9 subjects were smokers. Peri-implantitis was defined as radiographic bone loss amounting to more than 3 threads after 1 year of restoration, bleeding on probing and or suppuration from the peri-implant sulci. 26 implants were diagnosed with peri-implantitis, none of which were mobile. Clinical and radiographic evaluations were obtained at baseline, 1 and 5 years. Microbiological samples were collected at baseline, 6 months, 1 year and 5 years. Following the baseline examination, the suprastructures and abutments were removed and the implants were surgically exposed. Following local anesthesia, full thickness flaps were reflected buccally and lingually. After degranulation the implant surfaces were cleaned using 10% hydrogen peroxide followed by careful rinsing with saline. The abutments were resterilized and new rubber gaskets applied. The abutments were replaced and the flaps were sutured using interrupted sutures. After 2 weeks mechanical healing was performed mechanical cleaning was initiated and systemic antibiotics were prescribed according to the microbiological analysis. The patients were placed in a recall and maintenance program every 3 to 6 months for 5 years. If further bone loss was registered retreatment via mechanical and or surgical means and systemic antibiotics according to the treatment program given at baseline.

Findings: Sites with plaque and gingival bleeding decreased dramatically from 100% at baseline to 11% and 5%, respectively, at the 5 year registration. 7 implants (27%) present in 4 patients were lost during the 5 year period. Of the 19 remaining implants, four continued to lose bone. None implants showed an unchanged bone level and six gained bone (> 1 thread or more) after the treatment. In the remaining dentition 5 mm attachment loss at baseline was registered as maximum. No further attachment loss was noticed through the follow up period except for one patient in which two lower front teeth were extracted. 6 patients showed the presence of Aa at baseline while at 5 years this species was not recovered. *P. intermedia*/ *P. nigrescens* were recovered in 7 patients at baseline and 8 individuals at 5 years. *P. gingivalis* was detected in only one individual both at the baseline and final examinations. 4 patients were treated with antibiotics during 4 weeks, while the others were treated for 2 weeks only. The microbiological effect was not improved by the increased antibiotic treatment period.

Conclusions: 58% of the implants with sever peri-implantitis were resolved over a 5 year period using surgical and individualized antimicrobial treatment approaches.

Chung DM, Oh TJ, Shotwell JL, Misch CE, Wang HL. Significance of keratinized mucosa in maintenance of dental implants with different surfaces. J Periodontol 2006;77:1410-20. (ref 65)

Purpose: The need for keratinized mucosa and attached mucosa around osteointegrated dental implants for the maintenance of these fixtures has been a controversial topic. To date, studies that have advocated the need for keratinized mucosa around the coronal aspect of the implant have only investigated implants with rough surfaces. On the other hand, studies that have questioned the need for keratinized mucosa in this area have examined only implants with smooth coronal surfaces. Therefore, the aim of this study was to investigate the relationship between the presence or absence of keratinized mucosa and the long-term maintenance of dental implants with both smooth and rough implant surfaces.

Materials and Methods: A retrospective cross-sectional clinical investigation in which a total of 330 endosseous dental implants, in place for at least 3 years in 69 patients, were evaluated. The width of keratinized and attached mucosa was measured around each implant. The implants were organized according to the amounts of keratinized and attached mucosa into 4 groups: 1) keratinized mucosa <2 mm; 2) keratinized mucosa ≥ 2 mm; 3) attached mucosa <1mm; and 4) attached mucosa ≥ 1 mm. Each of the aforementioned groups were then further subdivided into smooth or rough implant surfaces. A modified plaque index (mPI), was taken as well as a gingival index (GI), modified bleeding index (mBI), and 4 pt. probing depths were taken around each implant in all 8 groups. A computer assisted calibration system compared radiographs taken at the time of the present study with previous radiographs to calculate the average annual bone loss for each implant. The type of implant prostheses (fixed versus removable) and the location of the implant placement (anterior versus posterior) was also noted.

Findings: The results from the study indicated that the amount of average annual bone loss around each implant from time of placement were not influenced by the amount of keratinized or attached mucosa or the type of implant surface (smooth versus rough). When comparing all of the subjects radiographically for average annual bone loss, the greatest amount of bone loss was found in rough surface implants with < 1mm of attached mucosa and in rough surface implants with < 2mm of keratinized mucosa. The results also indicated that less gingival inflammation and plaque accumulation was found around the implants with more keratinized mucosa and attached gingiva when compared to those implants with very little keratinized mucosa and attached gingiva. The results suggested that the amounts of keratinized mucosa were not significantly correlated with any clinical parameters of implants restored with either fixed or removable prostheses. Conversely, the presence of keratinized mucosa was shown to be significantly advantageous in maintenance of soft tissue health in posterior implants, indicated by higher GI scores in posterior implants without adequate amounts of keratinized mucosa (0.96mm) than those implants with an adequate amount (0.70mm)

Conclusion: Although the presence of keratinized and attached mucosa is not a critical factor in reducing average annual bone loss, it appears to be significantly advantageous in reduction of gingival inflammation and plaque accumulation.

EI Askary AS, Meffert RM, Griffen T. Why do dental implants fail? Part 1. Implant Dent 1999; 8:173-85. (92 refs)

Purpose: The purpose of this article was to define the causes of implant failure and to present an evaluation of the implant literature regarding etiology, classification, management, and treatment of implant failures.

Materials and Methods: Literature review.

Findings: Implant failure is defined as the total failure of the implant to fulfill its purpose (functional, esthetic, or phonetic) because of mechanical or biologic reasons. Warning signs of implant failure: 1) Connecting screw loosening 2) Connecting screw fracture 3) Gingival bleeding and enlargement 4) Purulent exudate from large pockets 5) Pain (not very common) 6) Fracture prosthetic component 7) Angular bone loss noted radiographically 8) Long-standing infection and soft tissue sloughing during the healing period of first-stage surgery. Connecting screw loosening is the major warning sign for the early stage of failure, indicating increased load on the implant components. Mobility, with or without purulent exudate, is the final evidence of failure.

Reasons for Dental Implant Failure:

The classification of dental implant failure is divided into seven categories: according to: A) the etiology; B) the timing of the failure; C) the condition of failure; D) the responsible personnel; E) the failure mode; F) the tissues involved; and G) according to the origin. Category A "According to Etiology" is concerned with the etiologic reasons for implant failures, which include implant failures because of host factors, surgical placement, implant selection, and restorative problems.

Host Factors: Medical Status: Osteoporosis and other bone diseases – Postmenopausal osteoporosis is a skeletal disorder in which there is a decrease in bone density and bone mass. It is considered to be a relative contraindication for osseointegrated implants, caused by decreased bone density, which negatively and substantially affects the implant-bone contact. Most other bone diseases are characterized by abnormal bone architecture (i.e. severe resorption, or diffuse radiolucencies/opacities, and spontaneous fractures as in Paget's disease). These characteristics are totally contraindicated for implant therapy. *Uncontrolled Diabetes* – Diabetes mellitus does not affect directly the failure of implants. Placement of implants in patients with metabolically controlled diabetes mellitus does not result in a greater risk of failure than in the general population; however, a group study stated that patients with diabetes experience more infection in clean wounds than patients without diabetes. The liability of infection is probably caused by thinning and fragility of the blood vessels so as to alter blood supply. Current surgical opinion is that patients with well-controlled diabetes probably do not encounter inordinate operative risks, but patients with poorly controlled diabetes still frequently experience wound failure. *Habits: Smoking* – Studies have shown that one of the primary factors that leads to implant failure is smoking. Bain and Moy stated "...it would appear likely that long-term smoking predisposes people to poor bone quality, which directly affects the lifespan of dental implants." It also seems likely that the reduced vascularity of bone is the predominant mechanism for failure in smokers. Smokers are twice as predisposed to failures as nonsmokers. *Parafunctional Habits* – Bruxing and clenching create mechanical and biologic complications related to prosthetic components, materials, and bone-anchored hardware or the state of osseointegration. This is the most common cause of implant bone loss or lack of rigid fixation during the first year after implant insertion. Failures occur with greater frequency in the maxilla because of the decrease in bone density and the increase in moment force. Bruxism is commonly manifested with the connecting screw loosening because of overload. The forces involved are in excess of normal physiologic masticatory load limits. Bruxism is not a contraindication for implants, but does influence the treatment planning. English and Balshi recommend more implants to be placed, eliminating cantilevers and occlusal contacts in lateral excursions, the use of an occlusal guard, and the use of wide-diameter implants to provide a greater surface area. Misch recommends increased time intervals between prosthetic restoration. *Oral Status: Poor home care* – A direct relationship between accumulation of dental plaque and the onset and progression of gingivitis has been

established. Dental plaque is one of the main factors that leads to implant failure. It is recommended that the patient be recalled frequently, preferably at a minimum of 3-month intervals. *Juvenile and rapidly progressive periodontitis* – A study by Gouvoussis et al. supports the proposition that transmission of periodontopathic organisms from periodontitis sites to implant sites in the same mouth is a likely event. IT calls the attention of the clinician to the potential cross-infection from periodontitis sites to implant sites. In cross-sectional microbiologic studies of failing implant sites, the data suggests similar microbial profiles between these sites and those of periodontal pockets. It seems there is a strong link between a periodontally involved patient and a dental implant failure. This is evidenced with the findings of increased Gram-negative anaerobic flora with high levels of spirochetes associated with failing implants. Evidence from these studies supports the concept that microbiota associated with stable and failing implants are similar to the microbiota of periodontally healthy and diseased teeth, respectively. *Irradiation therapy* – The relationship between dental implant failure and the irradiated patient is not clear. The main problem with irradiated patients is xerostomia, the liability for infection because of the decreased blood supply, and the possibility of osteoradionecrosis. The complication of radiation starts when the dose exceeds 64 Gy. Some authors state that the maxilla is more liable to failure with dental implants after irradiation, whereas the side effects are more serious in the mandible because of its inferior blood supply. The waiting period between the end of radiation therapy and implant placement is not definite. Some authors suggest 3-6 months, others suggest 6 months, and some recommend a 12 month waiting period. Finally, it seems the failure rate of dental implants after oral radiotherapy is minimal, however, it is recommended to wait for a longer healing period and to use hyperbaric oxygen therapy, especially in the maxilla.

Surgical Placement: Off-axis placement (severe angulation) – Improper implant placement can result in a framework design that compromises esthetics and distribution of force on implants. When faced with significant alveolar resorption, the surgeon has one of three options: 1) either to graft the area to place the implant properly; 2) to place the implant with an angulation; or 3) to use an angulated abutment so as to achieve the proper alignment with the opposing arch or the adjacent natural teeth. Prerestoring the implant position by grafting to avoid offset loading is recommended. Offset loading results in a combination of force vectors, mainly shear and tensile stresses. Endosseous root-form implants distribute occlusal load best in an axial direction, but if the occlusal load is in a lateral direction, many damaging stresses are generated directly at the crest of bone. A concept has been proposed that angle change over 25° will cause an implant to fail. Balshi et al. indicated that angulated abutments have exhibited good preliminary results and may be considered comparable with the standard abutment as a predictable modality in prosthetic rehabilitation as based on a study performed on Branemark implants. Also, Balshi et al. stated that preliminary results indicated that the use of angulated abutments did not increase failure rates. *Lack of initial stabilization* – There are not enough recorded data regarding the size of the gap between the implant and the bone that would lead to failure. Because the size of the gap is not definite, slight oversizing of the osteotomy may not be a serious problem. In an investigation by Ivanoff et al, gaps in the range of 0.25 mm around implants healed, but with less bone contact than the controls. When the gap size was increased (0.7-1.7 mm), a thin soft-tissue layer was found to develop around the implant. Mastering of the surgical skills, proper drill grip, and the use of sharp drills are all factors that should lead to precise site preparation. This improves the success rate of implant therapy by optimizing implant bone contact. *Impaired healing and infection because of improper flap design or others* – Improper flap design could lead to an early infection at the implant site which could jeopardize the implant status. Esposito et al. stated that the clinical signs of infection observed during the postoperative submerged period may lead to an increased risk of implant failure. Hunt studied the effect of flap design on healing and osseointegration of implants. He found there is no single flap design that seems optimal for implant surgery. He recommended that basic surgical procedures, flap design, blood supply, visibility, access, and the primary closure are the factors that should be regarded in implant placement. *Overheating the bone and exerting too much pressure* – Minimal temperature elevation during surgical drilling of the bone is a key factor in atraumatic surgical technique. Bone cell death occurs at a temperature of 47° C and higher when drilling is performed for 1 minute. There is a strong correlation between overheating the bone and implant failure. It is

recommended that a speed of no more than 2,000 rpm with a graded series of drill sizes be used and that external irrigation helps to prevent heating the bone. *Minimal space between implants* –

A space of 4 – 7 mm between the neighboring implants is recommended to allow sufficient biologic space to avoid the necrosis that could happen because of blood supply impairment. Meffert proposed that the minimum space between an implant and a neighboring natural tooth should not be less than 3 mm to avoid impairment of the periodontal ligament, whereas the minimum space between two adjacent implants should range from 3 – 5 mm depending on the type of bone. In very dense (type 1) bone, the minimal space should not be less than 5 mm to avoid overheating with subsequent death of the bone. However, in cancellous bone (types 3 and 4), this may be 3 mm because of the nature of the cancellous bone which will not be subjected to the danger of overheating as much as type I bone. *Placing the implant in immature bone-grafted sites* – One of the most common causes of prosthetically related implant failures is believed to be the too rapid loading the implant-supported prostheses. The problem with placing implants in grafted bone is timing; if the implant is loaded before the surrounding bone matures from woven bone into lamellar bone, then the failure incidence is much higher. Placing the implant in immature grafted bone will not provide intimate implant to bone contact, which is essential for the implant to resist applied torque. Placing the implant in mature fresh bone, the maximum implant to bone contact will be obtained. *Placement of the implant in an infected socket or a pathologic lesion* – Dental implants may fail because of placement of the fixture into either 1) an infected socket, 2) an existing pathological lesion, or 3) migration of infection from a neighboring tooth via marrow space. *Contamination of the implant body before insertion* – Contaminated handling of the implant is poor protocol and may alter surface chemistry. The implant may be contaminated because of manufacturer error, operator error, or by bacteria from the oral cavity. Implants can also be contaminated via metal transfer with nontitanium instruments and glove powder. Autoclaving a contaminated implant will back the bacteria on to the implant surface, so that when the implant is placed in the body, it becomes almost impossible for phagocytic cells to clean off this material. The implant surface should be cleaned by a radiofrequency glow discharge unit or plasma cleaner.

Implant Section: Improper implant type in improper bone type – Qualitative and quantitative considerations of bone must be evaluated before placing the implant. The amount of bone available and the position of anatomic structures ultimately define the designs of the implant to be used and its location in the arch. Self-tapping implant placement is recommended in the anterior mandible to avoid the increased trauma and heat generation that is produced by the bone tap. Tanaka et al stated that the self-tapping placement of the implant is indicated for soft bone, such as in the maxilla, based on the assumption that self-tapping implants could inflict surgical trauma in denser bone. *Length of the implant (too short, crown-root ratio unfavorable)* – A great variety of implant lengths exist between 7-20 mm, with the most widely used falling in the range of 10-16mm. Usually the length of the implant is advocated by the amount of available bone height. The success rate is proportional to the implant length and the quantity and quality of available bone. The long-term success of the implant is dependent on the amount of bone-implant contact. The placement of a short implant where bone permits a longer length would result in higher stress concentration leading to subsequent failure of the implant. The crown-implant body ratio affects the appearance of the final prosthesis along with the amount of movement of force on the implant and the crestal surrounding bone. The greater the crown-implant ratio, the greater the amount of force with any lateral force. The implant with unfavorable crown-implant ratio will be more influenced by lateral forces. The use of the greatest height of bone available is most important in D4 bone, as seen in the posterior maxilla. Therefore, sinus elevation are often indicated to improve significantly the surface area of contact to overcome the problem of reduced bone height. *Width of the implant* – Misch stated the primary criterion affecting the long-term survival of endosteal implants is the width of the available bone. It has been recommended that not less than 1 mm of bone surrounding the fixture labially and lingually is mandatory for the long-term predictability of dental implants because it maintains enough bone thickness and blood supply. Placing a narrow implant in a wide ridge, especially in the posterior area, is a compromising factor for long-term success because the smaller diameter design has greater crestal stresses that

increase toward the posterior. Using a wide implant in a narrow ridge results in labial or lingual dehiscence that leaves the implant affected by the damaging shear stresses. *Number of implants* – Misch stated that the use of more implants decreases the number of pontics and the associated mechanics and strains on the prosthesis, and dissipates stresses more effectively to the bone. It also increases the implant bone interface and improves the ability of the fixed restoration to withstand forces. *Improper implant design* – The design seems to affect the success rate of dental implants. Cylindrical and screw implants are better than conical or stepped implants from a stress distribution point of view. Press-fit systems are also easier and faster to place because bone tapping, the speed of rotation, and the direction of force in implant insertion are less relevant. Implants with a rough surface or in which bone apposition proceeds faster generally have a lower prevalence of early implant failure when compared with machined titanium screw-shaped implants.

Dental implant Checklist – A failure checklist is presented to guide implantologists as the different reasons of failure.

Conclusions: Dental implant failure can be attributed to many reasons through the different stages of treatment. The more accurate the documentation of the data on failures, and the etiology of failure, the greater the chances of reducing such occurrences.

El Askary A, Meffert R, Griffin T. Why do dental implants fail? Part II. Implant Dentistry 1999;8(3):265-76

Purpose: To discuss failure categories in term of etiology, failure mode, failure type, failure origin, failure timing, responsible personnel, and different tissue types.

Materials and methods: Literature review

Findings and conclusion:

Category A: According to Etiology:

Excessive cantilever. Problems associated with cantilevers supported by dental implants include fracture of the prosthesis, loss of osseointegration and bone fracture.

Studies have shown that distal extended cantilevers must be approached more cautiously because an increased magnitude of occlusal forces is encountered in the first and second molar areas. Fingerlike extensions to keep a maxillary second molar from extruding maybe sufficient.

Pier abutment. Because of the difference in mean axial displacement between natural teeth and dental implants, placing the implant in a pier situation is significant.

Studies have explained that when the implant serves as a pier abutment, the natural tooth may become uncemented because the implant will act as a fulcrum. The report recommended the use of the stress breaking element as well.

No passive fit. Achieving a passive fit during prosthesis insertion is considered to be one of the key success of dental implants. A passive fit reduces long term stresses in the superstructure, implant components, and bone adjacent to the implants.

Some of the factors that impair achievement of a passive fit are dimensional changes in ceramometal restorations during firing cycles, improper impression techniques, improper spacer application, and use of an improper metal type for casting.

Improper fit of the abutment. Improper locking between the two parts of the antirotational implant device leads to an increased microbial population and increased strain on the implant components, with subsequent bone loss and rapid screw-joint failure.

Improper prosthetic design. The ideal implant treatment plan is based on the patient needs, desire, and financial commitments. Not all patients should be treated with the same restoration type or design.

Improper occlusal scheme. Occlusal trauma on implants is more offensive than on natural teeth because of the force dissipation difference and because the difference in proprioception.

Bending moments. This is defined as a situation which occlusal forces on an implant supported prosthesis exert a bending moment on the implant cross section at the crestal bone, leading to bone loss and/or eventual implant fatigue.

Connecting implants to natural dentition. this is a controversial and inresolved issue. English reviewed the different points of view regarding connecting natural teeth to dental implants and its relation to natural tooth intrusion. Some studies recommended the use of a nonrigid connection between natural teeth and implants.

Premature loading. Branemark stated that strict protocol requires a stress free healing period of 3-6 months for osseointegration to occur. Misch stated that at 16 weeks, the surrounding bone is only 70% mineralized and still has woven bone as a component.

Excessive torquing. Misch recommended at the initial delivery of coping fixation that the screw be tightened to approximately two-third of the final torque force and after 4 weeks may be tightened

to the full 20Ncm torque force. More than 20 Ncm of torque force could lead to implant failure depending on the surface used.

Category B: Timing of failure:

- 1) *Before stage II (after surgery)*
Dental implants are less likely to fail at this point of time.
- 2) *At stage II (with healing head and/or abutment insertion)*
This could be due to excessive torquing during abutment connection when inserted into grafted or D4 bone
- 3) *After restoration: this is the most common failure.* The most common cause is occlusal trauma.

Category C: according to origin of infection:

- 1) *peri-implantitis:* bacterial invasion of the peri implantitis tissue results in soft tissue inflammatory changes and rapid bone loss.
- 2) *Retrograde peri implantitis:* Misch described a retrograde implant failure possibly due to bone microfractures caused by premature implant loading or overloading, other forms of trauma, or occlusal factors.

Category D: according to condition of failure:

Meffert proposed a classification of failure including ailing and failing implants.

He described ailing implants as those showing radiographic bone loss without inflammation signs or mobility. Failing implants are those with progressive bone loss with clinical mobility and that are not functioning in the intended sense.

Category E: According to responsible personnel:

The success and integrity of the dental implant rely on cooperation among a dental team that consists of the general dentist, surgeon, prosthodontists, periodontists, dental hygienist, lab technician, and even the patient.

Category F: according to failure mode

- 1) *Lack of osseointegration:* this can occur during the early stages of treatment because of the inability of the woven bone interface to mineralize, which can result from surgical trauma, premature loading, infection, and surface contamination.
- 2) *Unacceptable esthetics:* the esthetic outcome of an implant supported restorations is affected by 4 main factors: Implant placement, soft tissue management, bone grafting consideration and prosthetic consideration.
- 3) *Functional problems:* Proper function of the implants is dependent on two main types of factors, anchorage related and prosthesis related. Anchorage related factors compromise osseointegration and marginal bone height. Prosthetic related factors results mainly from improper prosthetic design. A prosthesis that is in hypofunction will result in improper masticatory function because of improper grinding of food.
- 4) *Psychological problems:* failure to fulfill the patients expectations and failure to gain the patients acceptance and satisfaction with such treatment will definitely be considered part of the failure.

Category G: according to supporting tissue type:

- 1) *Soft tissue problems :* Gingival loss leads to continuous recession around the implant with subsequent bone loss. The relationship between the keratinized mucosa to withstand bacterial insult an in facilitating hygiene protocols and dental failures is not clear.

- 2) *Bone loss*: bone loss in the mandible is higher during the healing period, in the maxilla, bone loss is higher after abutment connection. These differences could be due to the higher vascularity of the maxilla, which allows faster remodeling during the healing period, and the compact nature of the mandible which withstands applied functional forces much better after abutment connection.
- 3) *Both soft tissue and bone loss*: If failure starts from the soft tissue, then it usually is considered to be due to a bacterial factor. However, if the failure starts at the bone level, then it is considered to be due to mechanical factor (occlusal overload and trauma). Both bone and soft tissue may be involved together.

Dental implant checklist (El-Askary-Meffert checklist)

Because of the lack of broad and long term statistics about dental implants failure, a failure checklist is presented to guide implantologist trying to determine the reasons for implant failure. According to the checklist, failure could be due to single factor or a combination of more than one. Proper data collection, patient feedback, and accurate diagnostic tools will help to point out the reason of failure.

Iqbal MK, Kim S. For teeth requiring endodontic treatment, what are the differences in outcomes of restored endodontically treated teeth compared to implant-supported restorations? Int J Oral Max Impl; 2007;22:96-119.

Purpose: To systemically review clinical studies of the survival of single-tooth implants and endodontically treated and restored teeth and to compare the results.

Materials and Methods: A systematic review of the literature was performed on electronic medical databases to find studies pertaining to dental implants and root canals. Key words "dental," "implant," and "single" were typed into the subject headings to find all the implant studies. On the other spectrum, the key words "conventional root canal treatment," "root canal therapy," "restored teeth," "outcome," "prognosis," and "survival" were used to find studies relevant to restored endodontically treated teeth. The initial search yielded a total of 1,797 citations for dental implants and 430 citations for endodontically treated teeth. All citations were reviewed two examiners and excluded from the study if they did not meet the specified inclusion criteria. Of the 1,797 implant studies, 55 studies survived this exhaustive screening process while only 13 of the original 430 endodontically treated studies were included in this study. From the studies that survived, the two reviewers assessed the survival rate of the single-tooth implants and restored root canal-treatment teeth. A tooth or implant lost was defined as a complete failure.

Findings: No difference in the survival rates between the two treatment modalities were noted. In other words, it was found that the number of implants and the number of endodontically treated teeth that failed were comparable.

Conclusions: The priority should be placed on preserving the natural dentition rather than extracting and placing an implant. Endodontic therapy allows for this while at the same time has a comparable survival rate. The investigators believe that restored endodontically treated teeth are as predictable compared to implants. The investigators were considerate enough to provide a consensus report written by the American Academy of Endodontics and the American Academy of Osseointegration.

Levin L, Nitzan D, Schwartz-Arad D. Success of dental implants placed in intraoral block bone grafts. J Periodontol 2007;78:18

Purpose: To evaluate the survival and success of dental implants placed in alveolar bone following guided bone regeneration using intraoral block grafts.

Methods and Materials: Files of 50 healthy patients (14 males and 36 females), with an average age of 45.4 years) who received 129 screw-type titanium dental implants placed in previously augmented sites, using intraoral block grafts, were reviewed. Patients included in the study received a total of 129 implants placed 5.2 ± 1.1 months before the procedure. Data collected from the files included the area of surgery, bone origin, implant location, implant survival, marginal bone loss, and complications. Statistical analysis was performed.

Findings: Overall 18% of patients were smokers. Post operative follow-up period ranged from 6 to 67 months (mean: 24.3 ± 11.2 months). Implants ranged in width from 3.25 to 4.7 mm and length from 10 to 16 mm. The overall survival rate was 96.9%. Marginal bone loss around implants ranged from 0 to 3.3 mm (average: 0.22 ± 0.45 mm). The 5 year cumulative survival rate was 88%. One additional implant was lost 6 years post implantation. Marginal loss around implants ranged from 0-3.3mm. Only 5% of the implants presented marginal bone loss greater than 1.5 mm over the follow-up time. Smoking was not found to be related to implant failure.

Conclusions: Implants placed in a previously augmented alveolar bone site using intraoral block grafts has high survival and success rates with minimal marginal bone loss.

Fabbro MD, Testori T, Francetii L, et al. Systematic review of survival rates for immediately loaded dental implants. Int J Perio Rest Dent 2006;26(3):249-63.

Purpose: To determine the survival rate of immediately loaded (IL) dental implants based on a systematic review of the literature and the influence of several factors on the implant survival rate (reconstruction, implant location and implant surface characteristics).

Materials and Methods: An extensive computer research of multiple electronic databases from 1966 to December 2005, a hand search for papers since 1990 to 2005. Main journals included in this report were Clinical Oral Implant research, The International Journal of Oral & maxillofacial Implants, The International journal of Periodontics & Restorative Dentistry, and the most relevant papers were used. Articles were included according to the following criteria:

1-prosthetic rehabilitation was applied within 48 hours of implant placement, 2.-at least 10 patients were treated, or 20 implants were placed, independent of the type of prosthetic restoration applied, 3.- the mean follow- up was at least 12 months (or a range exceeding 12 months), 4.-root-form titanium endosseous implants were used, 5.-the number and location of IL implants and the number, location, and timing of failures were clearly reported, 6.-implant survival rate was reported or calculable, 7.-the dropout rate was less than 5% during the first 12 months of follow-up.

When different loading time frames were adopted in a single study, cases loaded later than 2 days after implant placement were excluded. All the data was independently performed by two reviewers using a standardized form, any disagreement was resolved with a discussion.

The data abstracted from each study was:

1. - Timing of implant loading, 2.- number of patients treated, 3.- total number of implants placed (IL plus submerged, if present), 4.- number and location (mandible, maxilla, anterior, posterior) of IL implants, 5.- type of prosthetic reconstruction, 6.-duration of follow-up, including range and means, 7.- number of IL implants failed, with location of failure, time of failure, and reason for failure, 8.- implant survival rate (ISR), 9.- life table analysis with 1-year intervals (if present), 9.- type of implants used and type of implant surfaces used, 10.-type of study design: randomized controlled trial (RCT), controlled trial (CT), case series (CS), retro-spective analysis (Retro), or other (such as review articles, technical reports). Data were primarily allocated to four main groups according to the type of prosthetic restoration: 1. - overdenture, 2.- full- arch fixed prosthesis, (3) partial fixed prosthesis, and (4) single crown, and then each group was subdivided (except overdentures).

The effect of implant surface micromorphology was examined by dividing the data from each group and subgroup into two classes: machined surfaces and rough surfaces. Statistical comparison between implant survival rates relative to different surfaces was performed by using either the chi-square or the fisher exact test, as appropriate. P=.05 was used as the level of significance. A general quality assessment was made based on information provided.

Findings and Results:

The present systematic review may be of utility to the clinician in that it provides information on the overall effectiveness of IL protocols in different clinical situations, based on a large number of observed cases. High ISRs (over 97%) were observed for maxillary full-arch prostheses, independent of the type of implant surface, biomechanical factors are critical to determine the excellent observed Implant survival rate.

Results indicated that literature search provided a total of 270 articles applicable to the immediate loading of dental implants, after reviewing all this articles only 71 met the inclusion criteria for quantitative data analysis and provided data relative to 2,977 patients and 10,491 IL implants. The overall Implant survival rate (ISR) is 96.39%, with the longest follow-up being 13 years.

The present review has examined these results grouped according to reconstruction type, implant location, and implant surface micromorphology as it follows:

- Mandibular Overdentures: 14 articles, 930 patients and 3505 implants in the interforaminal region. Implant survival rate ISR 95.13% (96.5% had rough surfaces), mandibular overdentures displayed the longest follow-up among all groups 53 months (range 6 months to 13 years).
- Fixed full-arch prostheses: 41 articles, 593 mandibles and 276 maxillae that were immediately rehabilitated with full-arch fixed prostheses supported by a total of 2693 and 2157 IL implants, the ISR was 97.25% for the mandible and 98.24% for the maxilla.
- Fixed partial prostheses: 12 articles, 166 patients and 503 IL implants, the ISR was 95.83%. 4 articles for the anterior mandible with 37 cases and 105 implants, for the posterior mandible, 127 prostheses supported by 384 IL implants ISR anterior mandible 99.05% and posterior mandible 94.79%, ISR mandible 87.37% and maxilla 97.16%, no significant difference was detected on the anterior region. 11 studies in the maxilla for 131 patients and 383 IL, ISR was 93.47%, six studies in the anterior maxilla for 44 cases and 124 implants, ISR of 93.55%. For the posterior maxilla, 60 prostheses supported by 180 IL implants were reported in 8 studies ISR of 92.78%.
- Single crowns: 15 studies on 206 single tooth reconstructions in 177 patients, ISR 97.57%. 55 patients, 55 IL implants in the anterior mandible with ISR of 96.36%. 8 studies for the posterior mandible 114 patients, 134 IL implants with an ISR of 97.76%. 23 studies, 761 reconstructions in the maxillae of 676 patients, with 96.19%. 18 studies on the anterior maxilla, for 556 patients and 625 implants with an ISR of 96.96%. 8 studies for the posterior maxilla, 59 patients treated with 72 single-tooth restorations, ISR 93.06%.

Additional investigation was conducted to evaluate the survival rates of IL single crowns supported by implants that were placed either immediately postextraction or in previously edentulous sites, the overall ISRs was 96.1% (336 implants) for the postextraction sites and 98.5% (134 implants) for the edentulous sites.

More than 80% of failures of IL implants occurred during the first 6 months of service and 97.1% took place within the first year of service, only 4 implant failures occurred after the first 12 months of loading.

Conclusions:

- IL is well documented and predictable for the completely edentulous mandible.
- The choice of the type of implant and the careful patient selection, may significantly influence the outcome of the treatment.
- A textured surface may be preferred in some clinical situations, such as partial reconstructions in poor-quality bone.
- Implants placed in postextraction sites can be successfully placed into immediate function.
- Further research is needed to document the long-term outcome of the IL protocol.
- Long-term clinical trials with a high level of evidence and adequate sample sizes should be performed to specifically determine the actual effectiveness of IL versus the standard delayed loading protocol.

Bogren A, Teles R, Torresyap G et al. A three-year prospective study of adult subjects with gingivitis. I: clinical periodontal parameters. J Clin Periodontol 2007; 34:1-6.

Purpose: To monitor prospectively clinical parameters in subjects without signs of destructive periodontal disease who were involved in a primary prevention program, and to determine the changes that occurred between yearly examinations over a 3-year period.

Materials and Methods: 126 subjects were selected from a total of 160 subjects participate in the study. The subjects had to be at least 20 years of age, have at least 24 natural teeth, have 2 or less sites with a probing pocket depth (PPD)>4 mm and no proximal sites with clinical attachment loss. Subjects were excluded if they had a systemic condition or were on medications that could be expected to influence the initiation of periodontal disease or if the required antibiotic prophylaxis for routine dental procedures. All subjects received primary prevention in the form of supragingival scaling and reinforcement of proper oral hygiene procedures every 6 months for 3 years. Clinical examinations were performed at baseline before primary prevention and then at 1, 2 and 3 years. Those clinical parameters included plaque score, bleeding on probing (BOP) and PPD. Those clinical parameters were taken at 6 sites of each tooth excluding the distal of the last molars. Data analysis was performed.

Findings: The mean age of the subjects included in the study was 38 years and ranged from (24-73 years). 14% of the subjects were smokers. During the 3 year study interval none of the participants had been on any antibiotic or anti-inflammatory drug therapy for 10 days. There were no significant changes in the plaque scores over the 3 years. After year 1, the BOP score was significantly improved with 5.6%, with no significant improvements at 2 and 3 years examination. The mean PPD decreased from 2.3 to 2.1 mm with an annual decrease of about 0.1mm/year over the 3 years.

Conclusions: The authors concluded that subjects exhibiting minor signs of periodontal pathology may benefit from a primary prevention program evident by reductions in PPD and BOP with the bulk of the changes happening in the 1st year of the program.

Renouard F, Nisand D. Impact of Implant length and diameter on survival rates. Clin. Oral Imp. Res. 17 (suppl. 2), 2006;35-51.

Purpose: Evaluated the survival rate of oral implants related to their length and diameter.

Materials and Methods: Inclusion criteria:

- Relevant data on implant lengths and diameters
- Implant survival rates were either clearly indicated or calculable from data reported in the paper
- Criteria for implant failure had been clearly defined
- Implants were placed in healed sites
- Human-derived data were reported

A Medline search between January 1990 and December 2005. A manual search of the following journals from 1990-1995. A further manual search was conducted through the bibliographies of all relevant papers and review articles. Two examiners reviewed the titles and abstracts according to the inclusion criteria. Data extracted from the review were classified as follows:

- Studies dedicated to short length implants
- Studies with data available on length
- Studies mainly dedicated to wide diameter implants
- Studies dedicated to narrow diameter implants
- Studies with data available on diameter.

Findings and Conclusions: The Medline search provided a total of 182 articles for dental/oral implant and length 103 articles for dental/oral implant and diameter 39 articles for dental/oral implant and shape and 102 articles for dental/oral implant and short dental implant of which 67 were screened as full text articles. A total of 53 human studies fulfilled the inclusion criteria and were divided as follows: 13 short length implants 21 implant length 9 wide diameter implants seven narrow diameter implants and eight on diameter. Implant length a higher failure rate was documented for shorter implants. The worst results with short implants have been documented with an overall survival rate of 75% for 7mm long implants of the 12 implants placed there were lost. With an overall survival rate of 74.4% for 7 mm long implants of the 55 implants placed 12 were lost. Only a few of these studies analyzed the statistical differences between short and longer implants. Shorter implants tended to fail significantly more often following uncovering and after loading than longer implants. 60% of all failed implants were short \leq and that the cumulative success rate for these short implants was significantly lower.

- Van Steenberghe et al 1990: Longer fixtures failed to a lesser extent compared with the shorter standard implants (7-, 10- and 13-mm long). The 7-mm implant failed more often (5.3%) than any other sized of implant in the maxilla.
- Bahat (1993): 7-mm implants had a higher failure rate than those of all other length. 60% of the failing 7-mm molar implants were the only implants in that segment of the jaw.
- Jemt & Lekholm (1995): Factors of significance for implant failures in patients were found to be age ratio of 7-mm implants and bone quality.
- Gunne et al (1999): Success rates reported in this study were achieved despite the use of short implants (54% of the implants were 7mm) and the failure rate was similar for 7-and 10-mm implants
- Winkler et al (2000): Shorter implants tended to fail significantly more often following uncovering and post loading than longer implants.
- Romeo et al (2004): Implant failure did not appear to be significantly influenced by length. Only 20% of failed implants were 8-mm long.
- Lemmerman & Lemmerman (2005): No correlation was found for implant length. This could be due to operator factors such as longer drilling time lesser ability of coolant to penetrate the osteotomy or inadvertent increased drilling force to get a deeper osteotomy.

Nine of these studies involved textured surfaced implants. One of the studies (Renouard & Nisand 2005) indicated a trend for better result with the use of textured surfaced implants compared with machined ones (97.6% and 92 % survival rates respectively). Four of these studies were devoted to

the treatment of the mandible. Bruggenkate (six of 45 short implants placed in the maxilla were lost giving an overall survival rate of 86.6%) acceptable survival rates in the jaw (94.6-100%). The worst cumulative survival rate of short implants (88%) was reported by Stellingsma et al. (2000).

- Renourad et al. (1999): Bone loss around wide diameter implants without a smooth collar is comparable to that reported around standard diameter implants. Bone loss that occurred before second stage surgery was observed primarily for long implants.
- Shin et al (2004) Although the wide implant suffered a significantly lower success rate compared with the standard diameter (87.5% for the 4mm-wide and 98.2% for the 3.75 mm wide diameter) implant the 5-mm diameter WP implants had a much lower CSR of 100% among the 5-mm RP implants.
- Polizzi et al. (1999): One failure occurred after about 66 months of function. Thus the results show a cumulative survival rate of 93.3% and an overall survival rate of 96.7%
- Andersen et al. (2001): 27 patient's received 28 standard diameter implants and 28 patients received 32 narrow diameter implants with 100% and 93.8% of CSR respectively. 2 narrow diameter implants were lost after 6 months but no others failures were subsequently observed in any of the groups. IN both groups marginal bone loss was recorded to be a mean of 0.4mm.
- Ivanoff et al.(1999): No relationship between the marginal bone loss and implant diameter was seen during the first year of loading. Shorter implants showed higher failure rates specifically within the 5-mm group (20%). IN the 3.75 and 4-mm group three of the 47 short implants failed.
- Lekholm et al.(1999): Shorter standard diameter implants were lost more often than longer ones whereas no wider diameter implants whatsoever were lost.
- Romeo et al. (2004): Implant failure did not appear to be significantly influenced by length and diameter.
- Lemmerman & Lemmerman (2005): No correlation (no effect on failure rate) was found for implant diameter.

This structured review has demonstrated a trend for an increase failure rate with short implants and wide diameter implants. The highest rates and increased failure rates for short implants were reported in older studies. The increased failure rates of wide diameter implants reported in some studies have been mainly associated with operators. More recent studies have reported survival rates for short implants and for wide diameter implants with long implants and standard diameter implants. In sites associated with poor bone density and jaw bone resorption a prevalence of short implants and or wide diameter implants might be used. Further research with higher level of randomized controlled studies should be preformed in order to investigate the relationships between bone density implant length and diameter and survival rates.