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Clinical management of single implant restoration in maxillary anterior region: A SystematicLiterature Review

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Abstract
Objectives:*To assesswhich surgical and restorative alternatives obtainbest esthetics outcomesfor single implant restorations in the anterior maxilla.****Methods****. Studies were identified with MEDLINE/pubmed, SCOPUS, Web of Science (WOS) and Cochrane CENTRAL. Twoindependent reviewers conducted the study selection, data extraction and evaluation of results.****Results:****46 articles were included; the review had been recruited 3,641 patients with 3,880 implants, 2,897 implants were immediate, of which 2,029 were flapless and 868 with full-thickness flap. Conventional placement was performed in 1,297 implants, 248 with flapless surgery and 584 with a mucoperiosteal flap. 465 implants placement technique were not specified, immediate provisional restorations were delivered on 2,166 cases while conventional loadings, placed after an average of 4 months from implant placement, were carried out on 2,028 cases. The highest mean pink esthetic score (PES), white esthetic score (WES)values (9.80) were obtained with conventional implant placement with bone grafts, similar to immediate implant placement with grafts reporting PES/WES values (9.70).****Conclusions:****Considering the patient's individual characteristics, the literature seems to indicate that the best aesthetic results can be achieved by placing an immediate implant with immediate loading and bone substitute augmentation, platelet-rich plasma (PRP membrane and connective tissue graft.*

Keywords: *Dental implant, Guided bone regeneration, Dental prosthesis, Oral Surgery*

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I. Introduction

In the anterior maxilla, the aesthetic implants failures can produce unacceptable clinical situations for patients and dentists that can only be corrected with implant remoting and the subsequent bone and tissue augmentation procedures. Regarding these scenarios, it is important to establish which surgical and prosthodontic alternatives obtain the best esthetic results, with long-term stability of the peri-implant tissues.[1,2]The most frequent causes teeth loss in the esthetic zone are: agenesis (33%), trauma (20%), endodontic complications (15%), caries (13%), trauma and endodontic complications (9%), periodontal disease (4%), orthodontic reasons (2%) and teethretained (2%).[2]The SAC classification system is an evaluation tool, developed by the International Team for Implantology (ITI), which allows assessing the difficulty by classifying prosthodontic and surgical clinical cases as S (simple), A (advanced) and C (complex) measuring the degree of complexity and the potential risk associated with each individual case. In this system, all aesthetic situations are classified into three categories: S (Straightforward), A (advanced) or C (complex), identifying the clinical challaneges present in the anterior maxilla.[3, 4] Scientific evidence reported that the ideal three-dimensional position of the implant is mesio-distally at 1.5 – 2mm from the surface of the adjacent root, while the neck of the implant should not be placed more apical than 2 mm of the cement-enamel junction.[3,4] On the vestibular-lingual perspective, the implant must be placed 1 mm palatine to the imaginary line joining the emergency points of the adjacent teeth. [2-4]This can be achieved by the use of surgical splints that highlight the gingival margin of the planned restoration.Despite the available scientific evidence, there is no consensus regarding which the ideal surgical and prosthodontic technique is to approach single implant restorations in the aesthetic sector to offer the best aesthetic results and the greatest predictability.

II. Methods

The review followed the guidance from the PRISMA (Preferred Reporting Items of Systematic Reviews and Meta-Analyses) Checklist to perform this systematic review.

Inclusion Criteria & Focused question

- Types of Studies. Previous systematic reviews, Meta-analyses, controlled clinical trials, perspectives, retrospective and case-control studies.
- Population. Partial edentulous patients in the anterior region of 1.1 and 1.2 the maxilla, with adjacent natural teeth and an alveolar process with a minimum of 4 mm of bone height.
- Intervention. Single implants rehabilitation with immediate placement protocol and immediate loading with ROG and connective tissue graft with a minimum follow-up of one year.
- Comparison. Late placement and conventional loading protocols.
- Results. Evaluation of dimensional changes of hard and soft tissues, and aesthetic results.

The focused question of this systematic review was: which the best treatment protocol for single implant rehabilitations in anterior maxilla sitein terms of aesthetics, survival and complications.

2.1 Exclusion Criteria

Studies with less of 10 patients. Studies in smokers of more than 10 cigarettes per day, with deficient plaque control (O'Leary plaque index> 25%), presence of active periodontal disease, presence of systemic disease affecting oral mucosa in the esthetic zone, presence of parafunctional habits, uncontrolled diabetes, presence of acute infection on the extracted tooth, a history of radiotherapy or osteoradionecrosis or any other condition that affects bone metabolism.

2.3 Search strategy

Studies were identified by entering the following search terms: 1# ((“Dental Implantation, endosseous” [MeSH Terms]) OR “Dental implants” [MeSH Terms] OR “Dental implants, single-tooth” [MeSH Terms] OR “Dental prostheses, implant supported” [MeSH]) AND (“Immediate implant placement” [All Fields] OR “Immediate dental implant loading” [MeSH Terms]) AND (“Maxilla” [MeSH Terms] OR “Esthetics, dental” [MeSH Terms] OR “Alveolar Bone Loss” [Mesh Terms])). The search was complemented by manual search on selected journals such as: “*Journal of Dental Research”, “Journal of Oral and Maxillofacial Implants”, “Clinical Implant Dentistry and Related Research”, “Clinical Oral Implants Research”, “The journal of Oral and Maxillofacial Surgery”, “The International Journal of Oral and Maxillofacial Surgery”, “Journal of Craniofacial Surgery”, “British Journal of Oral and Maxillofacial Surgery”, “Oral Surgery Oral Medicine Oral Pathology Oral Radiology and Endodonology” , “Medicina Oral Patología Oral y CirugíaBucal” , “Journal of Periodontology”, “Implant Dentistry”, “Journal of Clinical Periodontology” y “The International Journal of Periodontics & Restorative Dentistry”*.

2.4 Information Sources

The electronic search was conducted betweenMay and November of 2019, in the major databases of: The National Library of Medicine (MEDLINE/PubMed) via Ovid; Web of Science (WOS); SCOPUS and the Cochrane Central Register of Controlled Trials (CENTRAL), including studies published with no time or language restrictions until to the present. The level of agreement between the reviewers was estimated by Kappa statistics on the full-text selection. When the kappa statistic shows an agreement higher than 0.80, it is considered to provide substantial agreement between reviewers.

2.5 Study Selection

After retrieved the references, titles and abstracts were screened in duplicate by 2 independent reviewers (F.D. & C.C.V.). Once duplicates were removed and identified potentially included studies, screened full-text articles were obtained (F.D. & C.C.V.). The agreement was elusive and discussed eligibility until consensus was achieved. If this was not possible, a third reviewer (P.M.M.) assessed the final inclusion. Moreover, a searched among the reference sections of relevant primary studies, systematic reviews, and guidelines to identify additional studies.

2.6 Data Collection &ítems

Two reviewers (F.D. & C.C.V.)conducted data extraction. In case of any disagreementbetween reviewers, a third reviewer (P.M.M.) was consulted. The collected data were the authors, year, country, language of publication, type of study, the total number of patients, mean age, total number of implants with measurements, biomaterial used, soft tissue graft, surgery with or without flap, immediate or delay provisional crown, methodology used to measure the proximal bone levels, methodology to measure the buccal plate,

implant survival, follow-up, proximal bone loss and/or marginal bone loss, buccal plate loss, and main conclusion.

III. Results

102 studies were selected after applying the inclusion and exclusion criteria, finally 46 articles were included for the analysis. Of the 46 included studies, 21 were randomized clinical trials, 11 cohort studies, 6 case series, 4 systematic reviews and 4 clinical cases, showed on Figure 1. From the 46 studies, 2,897 implants were immediate placed, of which 2,029 wereflapless and 868 with flap to full thickness flap. 1,297 implants with early or delayed placement, of these, 248 with transmucosal surgery, 584 with elevation of a full thickness flap. In 465 implants the surgical technique of implant placement was not specified. (Table 1)The mean follow-up period, among the studies, was 3 years. 66 failed implants were registered. In 9 cases the definitive abutment was fractured. There were 12 cases of mucositis and 2 cases of periimplantitis. Thirty patients were lost due to leaving the study before finishing the follow-up period.In 28 articles, guided bone regeneration (GBR) technique was described for 1,519 sockets in immediate implant placement using in most cases a combination of Bio-Oss® (inorganic bovine bone) and autogenous bone (668 implants) and FDBA (cortical bone mineralized particulate), Biogram bone graft, tricalcium beta phosphate granules and cortical allograft (PUROS®)in the remaining 851 implants.For alveolar preservation, with delayed implant placement, the bone graft was used in 435 sockets, placing in most cases rhBMP-2 (human recombinant bone morphogenetic protein) andallograft bone in 104 implant sites.Remaining cases were grafted with cortical and cancellous heterologous bone (MP3), autogenous bone and tricalcium beta phosphate granules, DBBM (mineralized and deproteinized bovine particulate bone) and Bio-Oss were used.In most of the sites with GBR a resorbable collagen membrane was used.In 626 sites for immediate post-implant implant placement and in 353 sites for delayed implants, subepithelial connective tissue grafting was used.Instead of the connective tissue graft, in 33 cases with a delayed implant a PRF membrane was placed and in 17 cases an acellular dermal matrix (ADM) allograft was used (Table 2).The immediate provisional restorations were 2,166, while the deferred ones, placed after an average of 4 months of implant placement, were 2,028. The definitive restorations, with full ceramic crowns, were inserted on a mean of 5 months after implant placement.Regarding the aesthetic outcomes of immediate implants, 13 articles have been evaluated according to the PES index (range 1-14) / WES (range 1-10).The 165 immediate implants without grafts received an average PES of 11.04 and an average WES of 8, while in the 917 implants placed with connective tissue graft and guided bone regeneration they had an average PES of 10.36 and an average WES of 9.04. The aesthetic results of 186 delayed Implants without grafts with an average PES of 10.76 and an average WES of 8.55 were evaluated in 12 articles. The 486 delayed Implants installed with connective tissue grafting and GBR had a PES and an average WES of 10.68 and 8.93 respectively (Table 3). In 16 articles the average MBL (Marginal Bone Loss) of the implants was measured at the end of the follow-up period. Of the immediate implants without grafts, 67 implants showed an average MBL of 0.671mm after 1 year; 261 Implants: -1,015mm after 2 years; 164 Implants: -0.83mm after 3 years; 34 Implants: -1.14mm after 4 years; 60 Implants: -0.815mm after 5 years.Of the immediate Implants placed with connective tissue graft and ROG, 95 Implants showed an average MBL of 0.356mm after 1 year; 86 Implants: -0.513mm after 2 years; 55 Implants: -0.430mm after 5 years.The mean MBL in delayed implants without grafts was: 101 Implants: -0.380mm after 1 year; 233 Implants: -1,188mm after 2 years; 45 Implants: -1,100mm after 5 years. Of the Deferred Implants with connective graft and ROG: 238 Implants presented an average MBL of 0.555mm after 1 year; 15 Implants: -0.800mm after 2 years and 58 Implants: -0.38mm after 5 years. The average recessions in 12 articles were evaluated, 40 immediate implants reported an average recession of 0.5-0.9mm after 1 year; 835 Implants: -0.45mm after 2 years. 10/30 Implants had recession after 3 years; 8 Implants: recession> 1mm and 26 Implants: recession <1mm after 4 years; 673 Implants: -0.25mm after 5 years. Of the 10 articles that analyzed the average recessions were obtained: 250 delayed Implants: -0.07mm after 1 year; 243 Implants: -0.45mm after 2 years; 30 Implants: no recession after 3 years; 7 Implants: no recession after 4 years; 13 Implants showed recession and 58 showed a 0.45mm mucosal increase after 5 years.

IV. Discussion

Maxillary anterior single implant restorationsare a clinical challenge. Dimensional changes that follow a tooth extraction, especially in anterior sectorsdetermine the aesthetics of the gingival contour as well as the position and emergence of the implant. On the other hand, the symmetry determined by the extra an intraoral midline in this regionmakes it necessary to achieve a harmonic prosthetic rehabilitation. The best surgical and prosthodontic technique in implant treatment of implant crowns continues to be controversial when considering the different factors that influence success. In addition, anatomical factors, implant surfaces, implant macro-design, patient considerations and professional experience must be considered.The adequate three-dimensional position of the implant allows to achieve a stable aesthetic over time. In this aspect, Motta M. et al, 2016, conclude that the implant placement through guided surgery allows a three-dimensional insertion of the implant

much more accurately than a conventional technique.[37] However, in the present review 3 articles describe the use of guided surgery for 342 implants.Regarding soft tissue management, the studies of Berberi AN. et al., 2014 and Kanokwan N. et al, 2010, showed that obtaining gingival papillae, the distance between the contact point with the adjacent tooth and the bone crest must be less than 5mm (8, 14).Furhauser R. et al, 2015, Boardman N. et al, 2016, Rieder D et al, 2016, Cooper LF. and cols, 2014, and Ross SB. et al, 2014, affirm that implant placement through flapless surgery, causes less trauma to the soft tissues with the consequent lower recession compared with the muco-periosteal flap technique.[18, 20, 25, 40, 46]There is no consensus regarding the need for soft tissue grafts to achieve a better aesthetic outcome. On the one hand, De Bruyckere T. et al, 2015, state that the difference in tissue volume achieved with grafts, between thin and thick biotypes, is not significant. On the other hand, Kanokwan N. et al, 2010, conclude in their study that the thin gingival biotype is more susceptible to recessions, and therefore these patients may require soft tissue grafts.[8, 26]Alveolar preservation techniques have shown the best aesthetic clinical results in the studies of Cosyn J. et al, 2015, and Barone A. et al, 2015.[27, 32] The study of Mangano FG. et al., 2014, showed that ridge augmentation with ROG, with conventional implant placement, achieves excellent results and maintained over time. In this sense, the alveolar preservation allows a better maintenance of the bone tissue, allowing more predictable results.[23]Regarding immediate placement, the study by Boardman N. et al, 2016, and Esposito M. et al, 2015, affirmed that this technique supposes a lower reliability result. In addition, post-extraction implants loaded immediately may present a higher risk of failure and complications than delayed implants.[29, 40] However, authors such as Mangano F. et al, 2013, show that the technique of immediate implant placement, with adequate bone planning and availability does not increase the risk of failure.[10]There is a great variety of biomaterials to achieve adequate alveolar preservation. However, the lower reabsorption of the biomaterial results in better volume maintenance. Nevertheless, the bioavailability, the surgical experience and treatment costs can condition the choice of different biomaterials. Chen ST, 2007, reported that using Bio-Oss with a collagen membrane, a lower bone loss is obtained compared to only Bio-Oss graft or the absence of bone regeneration.[6] Subsequently ArRejaie A. et al, 2016, demonstrated that bovine bone substitute combined with autogenous PRP gel produced superior effects compared to the use of Bio-Oss with collagen membrane.[41]Regarding soft tissue management, Negri B. et al, 2016, highlight that the application of collagenized DBBM inside the shocket, covered by collagen matrix or autogenous soft tissue graft, achieves a lower vertical and horizontal reabsorption with respect to the Xenogeneic bone substitute technique, with or without gingival graft. Anderson LE. et al, 2014, demonstrated that the subepithelial connective tissue graft technique produced similar effects to acellular dermal matrix (ADM).[22, 34]Motta M. et al, 2016, affirmed that implant selection with a conical connection seems to minimize the loss of the periimplant bone tissue, with the consequent reduction of soft tissue recession around the implant.[37] The study of Hsu YT. et al., 2016, reported the use treated neck implants, together with a platform switchingwith lower bone resorption compared to implants with polished neck, although these differences have not been significant.[43] By contrast, Hartog L. et al, 2013, state in their study that the aesthetics of the single implants in the anterior maxilla are independent of the design of the implant neck.[9]Berberi AN. and cols, 2014, find that the placement of a definitive prosthetic abutment the same day of the implant placement, obtains a better integration of the soft peri-implant tissues and better aesthetic results. In addition, Vanlioglu BA. and cols, 2014, proposed the use of titanium or zirconia abutments and full ceramic crowns to achieve satisfactory aesthetic results.[14, 19]Ross SB. et al, 2013, established that the use of a customized anatomical temporary abutment resulted in a significant reduction in gingival margin changes.[17] After 5 years follow-up they found excellent stability of soft tissues without recession and excellent bone levels. In the same line, Furhauser R. et al., 2017, affirmed that the customized anatomical abutment prevents the collapse of the soft tissues, and achieves an emergence profile equal to of the natural tooth.[25]Comparing the results of the studies presented, it can be affirmed that both immediate and conventional implant placement, with or without bone or connective tissue grafts, obtain very similar results.The highest PES average value (11.04) was obtained in the immediate implants without grafts. However, with this method the lowest WES average value (8.0) has been achieved. It has been found that immediate implants with grafts had the highest WES average value (9.04), while the PES average value was the lowest (10.36). It turns out that the highest mean PES / WES (9.80) was described in the conventional placement with grafts, very close to immediate implant placement with graft (9.70). The lowest values are found in immediate implant placement without grafts (9.52) and those with convectional placement without grafting (9.65).Regarding of the implant design,studies affirm that the length of the implant does not influence aesthetics. Calvo-Guirado JL. et al., 2015, does not demonstrate a significant correlation between diameter, length and survival rate with marginal bone loss.[33] On the contrary, Ross SB. et al, 2014, find that the recession is directly related to the diameter of the implant, being smaller or absent around the implants with smaller diameter.[18]The present systematic review presents several limitations. Firstly, not all articles record all the information, the samples were not homogeneus, some results are heterogeneous or contradictory, not all the studies were carried out with the same methodology and some used different indexes or scales of measurement.

Many results are not statistically significant, and some studies have a much greater weight compared to others. These characteristics lead to the impossibility of developing a meta-analysis.

V. Conclusions

Despite the mentioned limitations, it can be concluded that immediate implant placements and conventional placements allow achieving satisfactory aesthetic results. Guided bone regeneration and alveolar preservation allow a better maintenance of the bone volume, although they diminish the predictability of the treatment. The use of soft tissue grafts allows to improve the aesthetics in those cases of fine biotype. The best maintenance of soft tissues and marginal bone level has been described in small diameter implants with conical connection, using immediate temporary abutments and a posteriorfull ceramic restoration.The presented results have to be considered with individual characteristics for each patient and each situation. Randomized clinical trials with homogeneous samples and with specific criteria are needed to establish the best surgical and prosthetic alternatives with the lowest risks for each clinical situation.

Conflicting interests

There are no conflicts of interest to declare.

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TABLES AND FIGURES

Figure 1. PRISMA systematic search flow chart

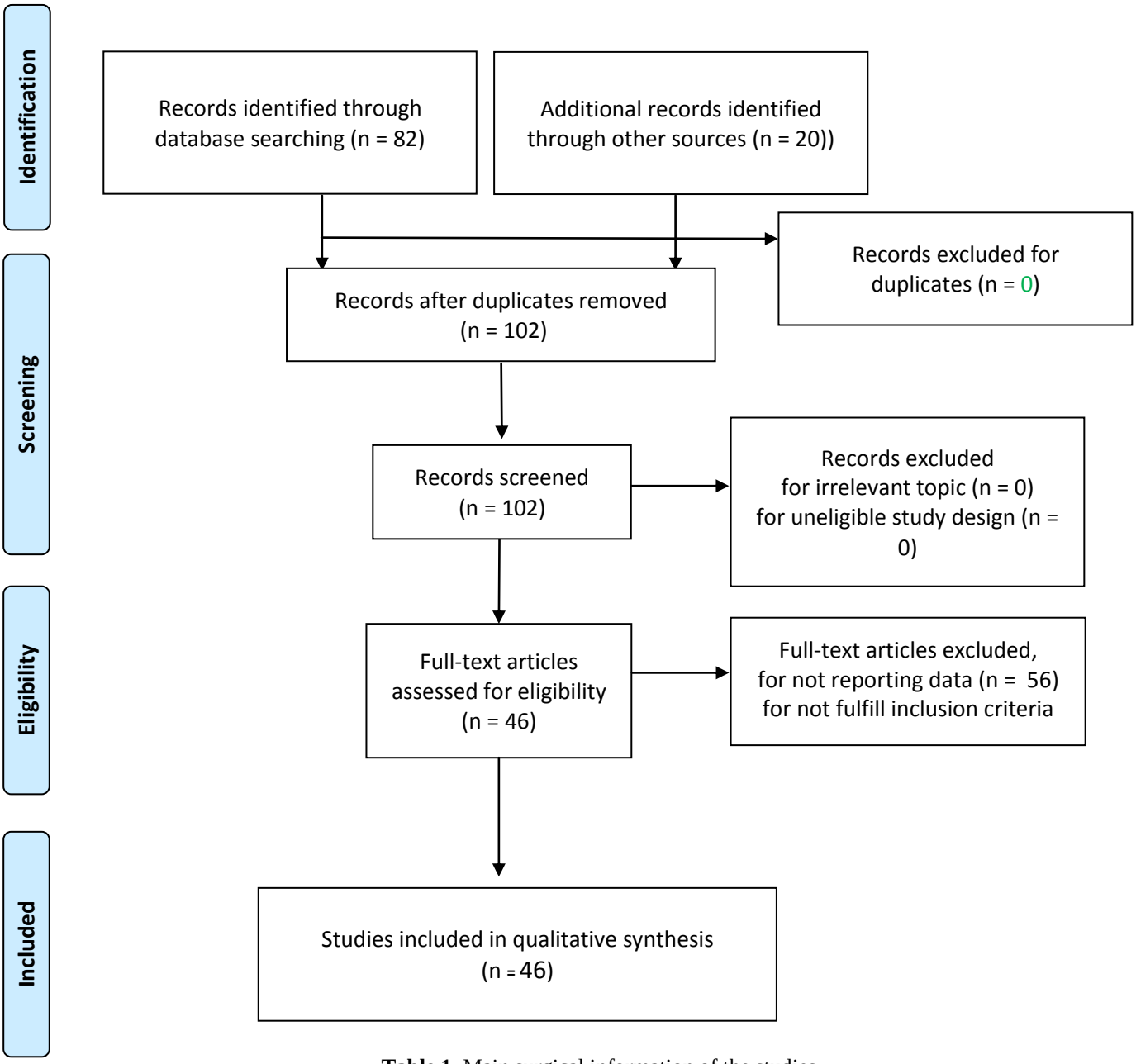

Table 1. Main surgical information of the studies.

Author, year	Number Patients/ Number implants	Intervention	Biotype	Esthetic evaluation	Follow-up	Complications
Tsirlis AT., 2005 (5)	38/43	Mucoperiosteal flap Atraumatic extraction Implant placement and GBR if required (19) Immediate implants (19) Delayed implants Immediate load	Unspecified	Mean Bone Loss: Immediate implants 0,75±1,05mm Delayed Implants+GBR 0,8±0,7mm Delayed Implants 1±0,7mm Proding depth: Immediate implants 0,3±0,2mm Delayed Implants 0,4±0,37mm	2 years	None

Chen ST et al.,2007 (6)	30/30	Mucoperiosteal flap Extraction (10) implant with non-submerged technique (10) bone graft (10) bone graft and membrane	Unspecified	Vertical Bone Loss: 81.2±5%; 70.5±17,4%; 68.2±16.6% Horizontal Bone Loss: 71.7±34.3%; 81.7±33.7%; 55±28.4% Non-submerged Implants more Horizontal bone loss (48.3 ± 9.5%) Bone Graft (15.8±16.9%) and Bone Graft and Membrane (20±21.9%) No Bone Loss: 19 cases Mucosa recession Vestibular placed implants (1.1±0.3 mm) Palatal placed implants (2.3±0.6 mm)	3 years	4 dehiscences 10 (33,3%) mucosa recession after 6 months 8 (26,7%) unsatisfied final esthetic because of recession
De Rouck T et al., 2008 (7)	267/267	(37) CylindricalImplants (230) ConicalImplants	Unspecified	Mean Bone Loss: 1 year: 0,2-0,5mm 2 years: 0,75mm. Mean mucosa recession: 0,55-0,75mm No differences in papilla level	1-52 months	Survival 78%- 93%
Kanokwan N et al., 2010 (8)	40/40	(32) Two-steps Implants (2) One-step Implants	Fine: 7 Thick: 33	Mucosa recession: 0.5-0.9 mm. Half or more papilla reached 89% More recession in fine byotipe, implant inclination, vestibular bone loss. Less papillareached at more distance from contact point to crestal.	1 year	None
Den Hartog L et al., 2013 (9)	93/97	Extraction (31) Smooth-neck Implant (31) Rough-neck Implants (31) Scalloped-neck Implants Placement after 3 months GBR and resorbable collagen membrane if required.	Unspecified	Mean PES (0-10): Smooth: 6,0±1,9; Rough: 6,3±1,7; Scalloped: 6,6±1,6 Mean WES (0-10): Smooth: 7,2±1,5; Rough: 7,4±1,6; Scalloped: 7,2±1,6 ICAI mucosa: Excellent: 2(2,2%); Satisfactory:50(54,3%); Moderate:18(19,6%); Poor:22(23,9%). ICAI crown: Excellent:3(3,3%); Satisfactory:54(58,7%); Moderate:27(29,3%); Poor:8(8,7%) Mean Bone Loss: Smooth: 1,19±0,82mm; Rough: 0,90±0,57mm; Scalloped: 2,01±0,77mm. Esthetic results depends on the need of previous surgery	18 months afterimplantplacement	1 SmoothneckImplantfailed
ManganoF et al., 2013 (10)	40/40	Mucoperiosteal flap Extraction (22) Immediate implants (18) Delayed implants	Thick	Mean PES: Immediate implants: 7,45±1,62 Delayed implants:7,83±1,58. Mean WES: Immediate implants: 7,04±1,29 Delayed implants:7,77±1,66. Best results PES/WES>18: 9/40(22.5%) Immediate implants: (3) 13.7%; Delayed implants: (6) 33.4% Acceptable results: 27/40(67.5%) Immediate implants: (17) 77.3%; Delayed implants: (10) 55.6% Poor results: 4/40 (10.0%) Immediate implants: (2) 9.0%; Delayedimplants: (2) 11.0%)	Mean 3 years	None

Krishnappa L et al, 2014 (11)	1/1	Mucoperiosteal flap Two-steps Implant Provisional Crown at 3 months	Unspecified	Limited bone widht (<6cm) Satisfactory esthetic with narrow implant and angulated abutment	1 year	None
Gungor MB et al., 2014 (12)	3/3	(3) Two-pieces zirconia Implants submerged-technique Provisional Crown at 6 months Definitive Zirconia Crown at 2 weeks	Unspecified	Clincal and radiographic success Patient esthetic satisfied	1 year	None
Chen, S.T al., 2014 (13)	591/607	607 Implants	Thick: Immediate implants. Fine and thick: Delayed implants	(PES max:14; WES max:10) Immediate implant +GBR+CTG: PES=12,75±0,25; WES=7,20±2,04 Delayed implants +GBR+CTG: PES= 12,62±1,05 WES=7.00±2,37 Best results (PES>12; WES>9): 8-21% Acceptable results (PES 8-11; WES 6-8): 58-68% Poor results (PES<8; WES<6): 21-24%	12-48 months	5 failureimplants
Berberi AN et al., 2014 (14)	20/20	20 Implants	Unspecified	Mean Bone Loss: At 2 months: 0,16mm At 1 year: 0,275 mm At 3 years: 0,265mm Immediate abutment placement reduce bone loss and reaches better esthetic results.	3 years	None
Bruno V et al., 2014 (15)	23/31	31 Implants	Unspecified	No Bone Loss At 1 year: Mesial Papilla IndexOptimal =3: 17.6% Distal Papilla IndexOptimal =3: 23.5% Mesial Papilla Index improved in 52,9% or stay in 35.2%. Worsen in 11.7% Distal Papilla Index improved in 29.4% or stay 64.7%. Worsen in 5.8%	6-12 months	2 Dehiscence of 2 mm
Carrillo de Albornoz A et al., 2014 (16)	25/25	Mucoperiostel flap (25) Delayed-implants 14 Titanium abutment 11 Zirconia abutment Non submerged-technique	Unspecified	Mean Bone Loss: Titanium abutment 0,06mm Zirconia abutment 0,45mm ICAI Index: Titanium 1 month (10,6) Titanium 1 year (11,3). Zirconia 1 month (7,9) Zirconia 1 year (7,6) Titanium abutment: 13 poor esthetic; 1 moderate. Zirconia abutment: 7 poor esthetic; 4 moderate. No statistically results	1 year	2 Zirconia abutment fracture
Ross SB et al., 2014 (17)	1/1	Immediateimplant	Unspecified	Reduce gingival marginal changes is posible with customized abutments. At 5 years no recessionorbonelossisobserved.	5 years	None
Ross SB et al., 2014 (18)	47/47	Atraumatic extraction Flapless immediate implant Cortical allograft	Thick: 36 Fine: 11	Mean mucosa recession: 0,30mm Mucosa recession>0,6mm 6/19 central incisor. Mucosa recession lateral incisor: 21/28 fue que de los Implant Lateral incisor3,mmdiameter (20/28): only 5 withrecession (0,08mm) Less recession is related to less	5 years	None

				implant diameter and flapless surgery		
Vanlioglu BA et al., 2014 (19)	47/55	Non submerged-implants	Fine: 10 Zirconia abutment Thick: 45 Titanium abutment	Mean PES Initial: 7,18±1,19 At 2 years: 7,87±1,17 At 3 years: 8,03±0,93 At 4 years: 8,14±1,07 Mean WES Initial: 8,15±1,11 At 2 years: 8,15±1,11 At 3 years: 7,92±1,06 At 4 years: 7,57±0,98	2-4 years	None
Cooper LF et al., 2014 (20)	113/113	(55) Immediateimplants (58) Delayedimplants	Unspecified	Mean Bone Loss: Immediate Implants: 0,43±0,63mm Delayed Implants:0,38±0,62 Delayed Implants: 59% bone gain or no change 21,6% bone loss >0,5mm Immediate Implants: 100% bone gain Papilla Immediate implant: Mesial: -0,13±1,61mm; Distal: -0,21±1,61mm Delayed Implant: Mesial: 0,39±1,52; Distal: 0,5±1,35 Gingival margin stability: Immediate implant: 65,2% Delayed Implant: 80,5% Mucosal dimension: Delayed implant and flapless: 0,78±1,34mm Delayed implant and flap: 0,19±0,79mm ImmediateImplantflapless: -0,05±0,92mm	5 years	First year: (3) Immediate implants failure (1) Delayed implant failure
Noelken R et al., 2014 (21)	20/37	Atraumatic extraction Rough Implant Bone graft	Fine: 4 Thick: 7 Regular: 26	Mean Bone Level: Initial: 0,82±0,96mm At 2 years: -0,07±0,58mm Mean PES: Initial: 10,65±1,96 At 2 years: 11,3±1,78 (26) 76% Improve or stable (8) 24% Worse Alveolar contour: Initial: 1,95±0,23 At 2 years: 1,61±0,5 Papilla measure: Mesial: 0,26 Distal: 0,12	2 years	3 Vertical boneloss> 1mm
Anderson LE et al., 2014 (22)	13/34	Mucoperiosteal flap (7) Conective tissue graft (6) Acellular dermal matrix graft	Unspecified	Mucosal dimensión gain CTG: 63% ADM: 105% Concavity reduction: CTG: 82% ADM: 96% Recession cover: CTG: 40% ADM: 28% CTG and ADM improve esthetic ADM worst postoperatory	6 months	None
Mangano FG et al., 2014 (23)	1/1	Mucoperiosteal flap Extraction Syntetic biphasic Calcium Phosphate block + Particulated graft + Collagenicreabsorbable membrane	Unspecified	Good esthetic even at periodontitis	2 years	None

		At 6 months: Non submerged implant				
Guarnieri R et al., 2015 (24)	21/21	21 Implants	Unspecified	Mean Bone Loss: Mesial: 0,98mm Distal: 0,90mm. Papilla recession >1mm: Mesial and distal (1) Mesial (16) Distal (15) Mean recession: 2.5mm Best results (PES>12; WES>9): 7 Acceptable results (PES 8-11; WES 6-8): 13 Poor results (PES<8; WES<6): 0	5 years	At 6 months: 1 failure At 24 months: 1 descemented crown
Furhauser R et al., 2015 (25)	27/27	27 Implants	Unspecified	Mesial/Distal papilla precence: Flapless: 89%/67% Flap: 57%/43% Mucosa contour: Flapless: 67% Flap: 43% Mean PES: Central incisor (18): 10.5 Lateral incisor (9): 12. PES>10 is related to minor desviation implant position (0,71±0,46mm) PES<10 is related to desviation>0.8mm of implant position.	1-5,7 years	None
De Bruyckere T et al., 2015 (26)	37/37	37 implants Connective tissue graft at 3 months	Fine: 13 Thick: 24	Mean mucosal width: Initial: 1.51mm Postsurgery: 2.59mm At 2 weeks: 2.94mm At 3 months: 2.46mm At 1 year: 2.50mm. Mucosal Gain: Fine byotipe: 0,96mm Thick byotipe: 0,97mm	1 year	None
Cosyn J et al., 2015 (27)	50/50	Bone graft At 4-6 months: Flapless implant and CTG Pacientes without recession (42), with recession (8)	Fine: 17	Mean Bone Loss: 0,48mm Mean papilla recession: 0,3mm Patients without recession (12) show mucosal coronally migration after CTG Patients with recession and CTG show mucosa gain of 0,9mm Mean PES: Initial: 10,9 1 year: 14 Mean WES: Initial: 8,2 1 year: 10	1 year	None
Felice P et al., 2015 (28)	50/50	Atraumatic extraction Bone graft (25) Immediate implant (25) Delayed implants Provisional crown	Unspecified	Mean PES: Immediate Implant: 12,78 Delayed Implants: 12,22 Mean Bone Changes: Immediate Implants: 0,13mm Delayed Implants: 0,19mm	2 yearsafter load	2 immediate implants failure 3 decementedprovisionals
Esposito M et al., 2015 (29)	106/106	Atraumatic extraction (52) GBR and Delayed Conical Implants (54) GBR and Immediate Conical Implant and immediate crown	Unspecified	Mean PES: Immediate Implants: 13 Delayed Implants: 12,8 Mean Bone Loss: Immediate Implants: 0,13mm Delayed Implants: 0,27mm	2 years	Immediate implants: 2 failures 8 complications (provisional fracture, provisional loss, 4 months incovenience, pain and implant mobility at 1

						month) Delayedimplants: 1 provisional loss
Cooper LF et al., 2015 (30)	141/141	Atraumatic extraction and GBR At 5 months: (48) Conical Implants;(49) Horizontal conection implants; (44) Platform switching implants Provisional crown	Unspecified	Marginal Bone Changes: Conical Implants: 0,22mm±0,28; Horizontal Conection: 1,20±0,64mm(FI); Platform Switching: 1,32±1,01mm Mucosal changes after Crown placement: Conical Implants: 0,0±0,5mm; Horizontal conection: 0,2±1,0mm; Platform Switching: 0,0±0,4mm Mean Papilla Changes: Mesial: 0,3±0,5mm; Distal: 0,2±0,5mm	1 year	Before 8 weeks: 10 failures Before 1 year: 3 failures
Khzam N et al., 2015 (31)	485/485	Atraumatic extraction Implant +GBR and CTG Immediate Provisional Crown	Unspecified	Mean Recession: 0,27±0,38mm Mean Papilla Loss: 0,23±0,27mm. Advanced Recession (>1mm) in 11,02% (119) Mean PES: >10 Never PES <8	1-5 years	11% advanced recession PES<7 in 11% cases
Barone A et al., 2015 (32)	33/33	Atraumatic extraction PRF membrane and MP3 bone graft At 5 months: Mucoperiosteal flap and implants with GBR	Unspecified	Mean Mucosal Gain: 0,15 ±0,5mm. Mean Bone Gain: 0,36±0,48mm Adequate esthetic	1 year	16 implants needed GBR 2 implants >1mm recession
Calvo-Guirado JL et al., 2015 (33)	53/71	Postextraction rough and platform switching implants	Thick: 32 Fine:21	Mean bone Loss from adjacent teeth: 0,86±0,29mm. Mean Mesial Bone Loss: 0,09mm Mean Distal Bone Loss: 0,11mm	3 years	None
Negri B et al., 2016 (34)	3/3	(1) Socket Shield and Immediate implant At 5 months: Roll flap and provisional (1) Socket Shield, collagen cap and CTG At 2 months: Implant and GBR (1) Socket Shield, GBR, collagen cap and CTG At 6 months: Implant and CTG	Unspecified	Esthetic stability of the results in all cases	1-2 years	None
Weigl, P et al., 2016 (35)	609/790	(790) Rough Conicalimplants	Thick: 379 Fine: 112	Interproximal mucosal changes <1mm Vestibular mucosal changes < 0.95mm	31,2 months	9 implantfailure
Guarnieri R et al., 2016 (36)	39/39	39 RoughImplants	Unspecified	Byotipe has no influence on papilla formation Implant position 1-2mm lingual to adjacent teeth to avoid recession Crestal Implant exposition of 0.5mm show mucosal stability Mean Mesial Bone Loss: 0,68±0,21mm. Mean Distal Bone Loss: 0,71±0,19mm.	5 years	None
Motta M et al., 2016 (37)	1/1	Atraumatic extraction Guided implant placement	Thick	Cono Morse implants show less bone los Guided bone surgery leads better tissue stability	6 months	None

Kolerman R et al., 2016 (38)	34/34	34 Platform-switchingimplants	Unspecified	Mean Mesial Bone Loss: 1,10±0,39mm Mean Distal Bone Loss: 1,19±0,41mm	4 years	At 1 week: (8) Subnasal/sub orbital hematoma (7) Suture dehiscence (16) Provisional descementation (2) Definitive descementation
Kolerman R et al., 2016 (39)	34/34	34 Platform-switchingimplants	Unspecified	At 1 year after Crown: Mean PES: 7,12±1,89 Mean WES: 7,32±1,25 Good or aceptable esthetic:91,2% Vestibular Mucosal Level: Optimal: (17) 50% Recession <1mm: 9 Recession>1mm: 8	4 years	At 1 week: (8) Subnasal/sub orbital hematoma (7) Suture dehiscence (16) Provisional descementation (2) Definitive descementation
Boardman N et al., 2016 (40)	98/98	Extraction (65) Bone level Implants (33) Tissue level implants GBR and CTG	Unspecified	Mean PES: 11 Acceptable esthetic: 94% Mean WES: 9 Acceptable ethetic: 98% CTG improves in 1 point PES Worse PES with membrane Flapless better esthetic. Immediate implant placement leads greater variability of esthetic	5 years	None
ArRejaie A. et al., 2016 (41)	32/32	Immediate implant Bone graft (16) PRP (16) No PRP	Unspecified	Mean Mesial Bone Loss: No PRP: 1,60±0,26mm PRP: 0,80±0,24mm Mean Distal Bone Loss: No PRP: 1,50±1,06mm PRP: 0,82±0,71mm Mean bucal bone gain: PRP: 4,98mm No PRP: 4,02mm Better results with PRP in tissue maintenence	1 year	None
Paolantoni G et al., 2016 (42)	65/74	(53) Postextraction implants (21) Implants at 1 month	Unspecified	Mean Bone Loss: At 2 years: One piece 1,4±0,99 mm Two pieces 1,17±0,89 mm	4 years	At 26 months: (3) Ceramic fracture (2) Screw fracture
Hsu YT et al., 2016 (43)	26/26	26 Flapless implants (13) Roughness platform-switching (13) Smooth straight	Unspecified	Mean Bone Changes: Roughness platform-switching: 0,21±0,56mm Smooth straight: 0,74±0,47mm Stability of mucosaltissues	1 years	3 Asintomatic vestibular boneperforations
Lombardo G et al., 2016 (44)	16/21	Atraumatic extraction (21) Locking-taper Implants Autologous bone graft and beta-tricalcic phosphate graft	Unspecified	Mean Bone Loss: 0,45±0,39mm Mean Probe Depth: 2,4±077mm Mean PES: 7,86±0,8; Mesial papilla: 1,62±0,5 Distal papilla:1,24±0,44 Mucosal Concavity and Contour: 1,71±0,46/ 1,62±0,5	2 yearsafter load	1 failure

				Root Convexity, Colour and soft tissue textura: 1,67±0,48 Mean WES: 9,5±0,8; Crown Shape and size 1,67±0,48 Colour and textura:1,76±0,44/ 1,95±0,22		
Zhao X et al., 2016 (45)	45/45	(45) Smooth neck delayed non-submerged implants	Fine: 20 Thick: 25	Mean Bone Loss: 1,1±0,92mm Vestibular Mucosal Recession: Fine byotipe: 9 Thick byotipe: 4 Mean PES: Initial: 8,48±2,62 At 5-8 years 9,01±2,45. Papilla Index improved Mean WES: Initial: 7,83±1,6 At 5-8 years: 7,72±1,43	5-8 years	12 mucositis 2 peri-implantitis
Rieder D et al., 2016 (46)	48/48	Atraumatic extraction and GBR (24) Immediate implants: (12) Submerged; (12) Non-Submerged (24) Delayed implants: (12) Submerged; (12) Non-submerged	Unspecified	Mean PES: Immediate submerged: 8.47±2.08 Immediate non-submerged: 7,93±3,21 Delayed submerged: 6,62±3,24 Delayed non-submerged: 8,10±3,25	1 year	None
Burgueno-Barris G et al., 2016 (47)	3/3	Implantplacement	Unspecified	Mean PES: 5,71; 4,87; 2,39. Mean WES: 7; 6,01; 3,77.	1 year	None
Wittneben JG et al., 2017 (48)	40/40	40 Implants and CTG	Unspecified	Crestal Bone Level Changes: Initial: −0.15 mm to 0.12 mm At 1 year: –2.3 to 3.2 mm). Mean PES: 7-7,65 Mean WES: 8,28-8,50	1 year	1 Abutment fracture
Furhauser R et al., 2017 (49)	77/77	Extraction Implant with custom abutment Immediate provisional crown	Unspecified	Mean PES: Initial: 11.9 At 5 years:12,6 Better puntuation at 6 month Alveolar process, soft tissue colour and textura show differences Mean mucosal recession: Initial: -0,1±0,5mm At 5 years: -0,3±1mm Better esthetic with alveolar socket preservation, early custom abutment	5 year	21% Widthbonelo ss
Vidigal GM et al., 2017 (50)	53/53	Extraction (37) Implant with bone graft (16) Implant with bone graft and CTG	Fine:16 Regular: 37	Mean PES: 8.63 ± 2.4 Mean WES: 6.92 ± 1.67 Mean esthetic results PES/WES: 15.55 ± 3.45 Favorable PES: 31 (58.49%) Optimal PES: 5 (9.43%) Desfavorable PES: 17 (32.07%) Favorable WES: 36 (67.92%) Optimal WES: 4 (7.55%) Desfavorable WES:13 (24.52%) Favorable PES/WES: 32 (60.38%) Optimal PES/WES: 2 (3.77%) Desfavorable PES/WES: 19 (35.85%)	4 years	(2) implant failure (2) aditional CTG (1) aditional bone graft (1) ab utment fracture (2) Cr own repetition (7) Descementati on