

Impact of timing of dental implant placement and loading: Summary and consensus statements of group 1. The 6th EAO consensus conference 2021.

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Abstract

Objectives: This publication reports on the EAO workshop group-1 summaries, discussions and consensus statements based on four systematic reviews evaluating the impact of timing in dental implant placement and loading.

Material and Methods: The first of the systematic reviews was on the influence of the timing of implant placement and loading in the biological outcomes of implant-supported fixed partial dentures. The second systematic review evaluated the influence of the timing of implant placement and loading on the aesthetic outcomes in single-tooth implants. The third systematic review was on the long-term outcomes of maxillary single-tooth implants in relation to timing protocols of implant placement and loading and the fourth on patient's perception of timing concepts in implant dentistry.

The group evaluated these systematic reviews, provided comments and additions as required and agreed on the relevant consensus statements as well as on clinical and research recommendations.

Results: Different timings of implant placement / loading presented with high implant survival rates. The systematic reviews evaluated from this working group provided a number of conclusions based on the available/current literature. However, the specific topic of timing is an area that further research is required in order to provide detailed guidelines for the different protocols to be employed.

Keywords: augmentation, biological outcomes, bone level changes, dental implant, delayed placement, delayed loading, early loading, early placement, immediate loading, immediate placement, implant supported multiple unit FDPs, implant survival, soft tissue-implant interactions, survival rate, timing of implant placement, timing of implant loading, patient reported outcome measures, patient satisfaction.

1. Does the timing of implant placement and loading influence biological outcomes of implant-supported fixed partial dentures? A systematic review and meta-analysis

1.1 Focused question

“Does immediate or early implant placement and loading influence the biological complication rate and implant survival in partially edentulous patients when compared with conventional protocols?”.

The implant placement and loading protocols for this systematic review (Aiquel et al. 2021) were adopted as proposed by Gallucci et al. 2018 and Siebers et al. 2010 (Gallucci, Hamilton, Zhou, Buser, Chen, 2018 and Siebers, D., Gehrke, P., & Schliephake, H., 2010).

- Immediate implant placement (IP): Dental implants are placed in the fresh socket on the same day of tooth extraction.
- Early implant placement (EP): Dental implants are placed with soft tissue healing or with partial bone healing, 4–8 weeks or 12–16 weeks after tooth extraction.
- Late implant placement (DP): Dental implants are placed after complete bone healing, more than 6 months after tooth extraction.
- Immediate loading (IL): Dental implants are connected to the prosthesis within 1 week subsequent to implant placement.
- Early loading (EL): Dental implants are connected to the prosthesis between 1 week and 2 months after implant placement.
- Conventional loading (DL): Dental implants are allowed a healing period more than 2 months after implant placement with no connection to the prosthesis.

1.1.1 Based on the long-term data, is there evidence regarding the outcome (survival/marginal bone levels) of immediate /delayed or late placement of implants in conjunction with different loading protocols for implant supported multiple-unit fixed dental prostheses?

1.1.1.a Immediate Placement

Survival Rate

The analysis of pooled data from two prospective cohort studies on 34 patients and 87 implants showed 90% survival rates for IPIL (20 implants/ 10 patients / one study) and 100% for IPEL (67 implants / 24 patients).

Marginal Bone Level

The analysis of pooled data from two prospective cohort studies on 34 patients and 84 implants revealed bone loss of 1.57mm for IPIL (17 implants/10 patients/ one study) and 0.34mm for IPEL (67 implants/24 patients/ one study).

1.1.1.b Delayed Placement

Survival Rate

In a meta-analysis of three RCTs (98 patients /370 implants), there was no significant difference in terms of implant survival comparing DPIL (74 patients /188 implants) vs. DPDL (182 implants / 72 patients). The weighted survival for DPIL was 96.1% and 97.4% for DPDL.

Marginal Bone Level

The analysis of pooled data from four RCTs on 471 implants/126 patients revealed a marginal bone level of 0.53 mm for group DPIL and 0.62 mm for group DPDL.

The analysis of pooled data from four prospective cohort studies and two case series on 345 implants and 158 patients revealed bone loss of 0.89 mm for DPIL (110 patients /192 implants / five Studies), 0.28 mm for DPEL (29 patients/107 implants/one study) and 2.46 mm for DPDL (19 patients /46 implants /one study)

Consensus statement

In the present systematic review, there were no differences in survival rates and marginal bone levels when DPDL and DPIL were compared.

The heterogeneity and quality of the data did not allow to draw any conclusions on immediate placement in conjunction with different timings of loading and marginal bone changes following different timing implant placement/ loading for implant supported multiple unit fixed dental prosthesis. At the same time, the working group indicated that caution is needed when interpreting pooled data from studies with different design which may not be comparable.

1.1.2 Does the use of bone augmentation procedures affect the implant survival?

Eight studies - three RCTs, two case series and three cohort studies including 310 patients / 770 implants provided information on bone augmentation procedures in conjunction with different timings of implant placement. However, due to the high variation of techniques and poor reporting on bone augmentation procedures no statement can be made whether bone augmentation in conjunction with different timings of implant placement and loading may affect implant survival.

1.1.3 Does implant design/surface affect the outcome (survival / marginal bone level)?

Due to a low number of direct comparisons and scarce information on implant features no conclusion can be drawn on the effects of implant design and surface in different implant placement and loading protocols. Within the included studies of this systematic review, mostly moderately rough implant surfaces were analyzed.

Surface:

One RCT compared 20 machined vs. 22 oxide anodized immediately loaded implants (DPIL) in 10 patients in a split mouth model in the posterior mandible. No significant differences in radiographic bone level nor plaque index (PI), probing depth (PD) and sulcus bleeding index (SBI) could be observed at 36 months follow-up. A survival rate of 90.9% for machined implant surfaces in comparison to 100% survival rate of the moderately rough oxide anodized implants was observed.

Implant design:

According to one RCT (DPDL) evaluating scalloped implants in comparison to those with a flat platform in the esthetic zone, significantly more marginal (scalloped: 3.4 ± 1.0 mm; flat: 1.5 ± 0.7 mm) and inter-implant bone crest loss (scalloped: 2.4 ± 1.0 mm; flat: 1.3 ± 1.0 mm) was observed (with the scalloped implants). A survival rate of 95% (16 patients / 32 implants)

for scalloped implants and (19 patients / 38 implants) 100% for flat platform implants was observed.

Consensus statement

The limited amount of data on the effect of implant surface and design on implant survival following different timing of implant placement/ loading did not allow to draw any robust conclusion.

1.2 Clinical recommendations

Following delayed implant placement, the timing of implant loading does not influence survival of implants supporting multiple-unit fixed dental prostheses.

The heterogeneity and quality of data did not allow to draw any robust conclusions on marginal bone changes following different timing concepts of implant placement in conjunction with different loading protocols of short span multiple-unit fixed dental prostheses. Therefore, no specific recommendation can be given as to specific timing of implant placement / loading, and the clinician should consider all related biologic, anatomical and aesthetic factors prior to the selection of any of these procedures.

1.2 Recommendations for future research

Future research should:

- Assess biological outcomes of implant supported multiple-unit fixed dental prosthesis in conjunction with different timings of implant placement/ loading protocols of multiple unit fixed dental prosthesis.
- Assess the impact of different bone augmentation procedures on biological outcomes in different timing of implant placement/ loading.
- Assess the influence of loading of provisionalisation on implant survival and biological outcomes in conjunction with different timings of implant placement/ loading protocols of multiple-unit fixed dental prosthesis.
- Assess the influence of implant design, surface and implant materials on biological outcomes in conjunction with different timings of implant placement/ loading protocols of multiple-unit fixed dental prosthesis.

- Evaluate the effect of designs and materials of the restorations of multiple-unit fixed dental prosthesis on implants survival and biological outcomes in conjunction with different timings of implant placement/loading.

2. Is timing of implant placement and loading influencing aesthetic outcomes in single-tooth implants?

The present systematic review (Francisco et al 2021) included data from 18 RCTs (with at least 1year follow-up), evaluating whether the timing of implant placement and loading could influence aesthetic outcomes. All included studies were related to single implant placement in the aesthetic area which in this review included the anatomic areas between 2nd premolars.

The timing for implant placement was defined as follows:

- Immediate implant placement (IP): implant placement at the same day of tooth extraction.
- Early implant placement (EP): implant placement from 10 days to 8 weeks after tooth extraction.
- Delayed implant placement (DP): implant placement from 3-6 months after tooth extraction.

The timing for implant loading was defined as follows ((Gallucci et al. 2018):

- Immediate loading (IL): dental implants were connected to the prosthesis within 1 week subsequent to implant placement.
- Early loading (EL): dental implants were connected to the prosthesis between 1 week and 2 months after implant placement.
- Conventional loading (DL): dental implants were allowed a healing period more than 2 months after implant placement with no connection to the prosthesis.

2.1 Focus question:

“In patients in need of a single-tooth implant (P), do immediate or early implant placement and loading protocols (I) influence the aesthetic outcomes (O) when compared with conventional protocols (C)?”

2.1.1 What were the clinical methods used to describe aesthetic outcomes in terms of timing of implant placement/loading in single implants?

All of the included RCTs (18) referred to changes of the peri-implant mucosa to describe the aesthetic outcomes. These terms included changes in mucosal recession and in papillae height/level. Different anatomical landmarks were used as a reference in the included studies.

The indexes used to describe aesthetic outcomes were the following:

- Pink Esthetic Score (PES) (Furhauser, et al., 2005)
- PES/White Esthetic Score (WES) (Belser, et al., 2009)
- Papilla Index Score (PI)(Jemt, 1997)

2.1.2 What is the impact of flap versus flapless approach in terms of aesthetic outcomes in the anterior area (between second premolars)?

In 14 RCTs, a flap was elevated for implant placement in all groups, whereas, in 2 RCTs on immediate implant placement a flapless approach was reported

Based on the design of this review, it was not methodologically appropriate to make conclusions on aesthetic outcomes in relation to the effect of flap vs. flapless approach.

2.1.3 Does the timing of implant placement affect the aesthetic outcomes?

Three RCTs (138 patients, 138 implants) compared IP to DP and showed various results in terms of mid-facial recession with no consistency in favour of one timing in implant placement. One RCT favoured IP, one favoured DP and another showed no difference between the two groups (IP/DP) .

Three RCTs (190 patients, 190 implants) compared IP to DP and reported no statistically significant difference in the PES score at 1 year after loading. However, one RCT (115 patients, 115 implants) reported a statistically significant difference on the PES between IP to DP, with IP presenting worst aesthetic results.

In two RCTs (51 patients, 53 implants) comparing IP to EP no difference was found on mid-facial recession/mucosal margin changes at 1 and 2 years of follow-up.

In one RCT (35 patients, 35 implants) comparing IP to EP there were no differences in the papilla height and PES with both groups presenting papillae recession in the range of 1.0 mm in 1 year follow-up.

One RCT (28 patients, 28 implants) found no difference between EP and DP in the PI at 10 years of follow-up.

Consensus statement:

Immediate/early/delayed implant placement represents three different surgical protocols, with individual difficulties and influencing variables that may affect the final aesthetic outcome of single implant restorations. Aesthetic results can be achieved independently of timing of

implant placement. From the data in this review and in relation to aesthetic outcomes (mid-facial mucosa changes, papilla height and aesthetic indexes), no recommendation can be made in favour of a specific timing for implant placement.

2.1.4 What is the impact of immediate provisionalisation (including loading) on the aesthetic outcomes for different timings of implant placement?

In this systematic review, immediate provisionalisation was defined as the use of a temporary restoration within 48 hours after implant placement irrespective of presence of functional/occlusal loading.

2.1.4.a Immediate implant placement with immediate provisionalisation/loading (IP+IL)

Based on three RCTs (123 patients, 123 implants), comparing IP+IL to IP+DL conflicting evidence was found in relation to the changes in midfacial mucosal recession and papillae height/level.

In one RCT (46 patients, 46 implants), there was a statistically significant difference in terms of mid-facial recession, favouring IL at 1 year of follow-up. However, two RCTs (77 patients, 77 implants), reported no differences in terms of midfacial mucosal recession and papillae height/level at 1-year of follow-up.

In one RCT (39 patients, 39 implants), there was no difference in the PES/WES index at 1 year.

2.1.4.b Early implant placement with immediate provisionalisation/loading (EIP+IL)

In one RCT (16 patients, 16 implants) comparing IP+IL to EP+DL the midfacial mucosal margin changes were not significant at 2 years.

2.1.4c Late implant placement with immediate provisionalisation/loading (DP+DL)

In four RCTs (142 patients, 142 implants) comparing DP+IL to DIP+DL, no difference in midfacial mucosa recession was found between the two groups at 1 year and at 5 years

In three RCTs (199 patients, 199 implants) comparing DP+IL to DP+DL, no difference in papillae height was found between groups at 1 year and at 5 years .

In four RCTs (157 patients, 157 implants) comparing DP+IL to DP+DL, no difference was found in PES/WES at 1 year, in PES at 2 years and in PES/WES at 5 years. Two RCTs (65 patients, 65 implants) reported an improvement of the PES between initial evolution and 1 year of follow-up.

Consensus statement:

The results from this review (Francisco, et al., 2021) suggest that there are no differences in aesthetic outcomes between IP+IL, EP+IL and DP+DL. Furthermore, there is a trend that the midfacial mucosa and PES changes observed in the first 12 months of healing, are not maintained/observed in the long term (up to 5 years).

2.1.5 Is there an effect of implant design/surface in conjunction with different implant placement timing/loading protocols on aesthetic outcomes?

The RCTs included in this SR presented with a heterogeneity in implant design and surface. The included studies used mostly tapered design and moderately rough surface. The evaluation/comparison of the implant design/surface was not within the scope of this SR and no conclusions on a possible effect on aesthetic outcomes could be drawn.

2.1.6 What is the impact of the soft tissue phenotype at the site of extraction in conjunction with different timing of implant placement /loading protocols on aesthetic outcomes?

Whilst three RCTs reported on the gingival phenotype at the surgical site, with most of patients having a thick/flat phenotype, the studies did not correlate (the phenotype) to the aesthetic outcomes following different timing of implant placement/loading.

Therefore, and within the limits of this SR, no conclusions could be provided correlating the phenotype to aesthetic outcomes.

2.2 Clinical recommendations

- Careful case selection and evaluation of all factors that may affect aesthetic outcomes is required according to different timing of implant placement and loading.
- For the assessment of the aesthetic outcomes of single implants, the baseline measurements should be based on fixed and reproducible landmarks.
- The clinician may use immediate loading/provisionalisation of single implants without compromising the aesthetic outcomes in the medium term.

2.3 Recommendations for future research

Future research should:

- Consider aesthetic outcomes as a primary outcome measure in relation to different timings of implant placement and loading.

- Evaluate the impact of gingival phenotype in aesthetic outcomes following different timings of implant placement/loading.
- Define the baseline and the follow-up time points to assess the aesthetic outcomes following different implant placement/loading.
- Analyse the influence of 3D-planning/guided implant placement on aesthetic outcomes following different timings of implant placement and loading.
- Define the impact of the design/material of the abutment/supra-structure on aesthetic outcomes following different timings of implant placement/loading.
- Evaluate the effect of the use and timing of soft and hard tissue augmentation procedures on aesthetic outcomes following different timings of implant placement/loading.

3. Medium to long-term outcomes of timing concepts of placement/ loading of single tooth implants in the anterior maxillary region.

The consensus statements related to this systematic review (Pommer et al. 2021) are based on outcomes of studies reporting on an observation period of ≥ 3 years of implant function. Due to limited amount of available literature, and in order to capture all relevant information in this topic, in addition to RCTs (n= 6), prospective (n= 13) and retrospective (n=10) studies have also been considered.

In this systematic review, only implants placed in the anterior maxilla were evaluated, as bone remodelling patterns may be different in maxillary premolar areas compared to incisors and canines.

3.1 Objectives:

- The primary objective was to compare survival rates of implants with different timing of implant placement / loading of single-tooth implants in the anterior maxilla with an observation period of more than 3 years.

- The secondary objective was to investigate the impact of different timing of implant placement / loading of single-tooth implants in the anterior maxilla on the peri-implant bone level.

3.1.1 Is there evidence regarding the implant survival / bone level of different timing of implant placement and loading?

3.1.1.a Immediate implant placement:

A meta-analysis of three RCTs (196 patients, 201 implants) has shown an implant survival of 96.2% with immediate placement/immediate loading (IPIL) and 98.3% with immediate placement/delayed loading (IPDL) with no significant differences between the groups after a follow up of 3-5years. In two of these studies (70 patients, 70 implants), the comparison of the marginal bone loss between the two loading protocols did not show significant differences.

3.1.1.b Early implant placement:

A meta-analysis of one RCT (22 patients, 22 implants) and one CCT (18 patients, 18 implants) compared early vs. delayed implant placement both being subjected to delayed loading (EPDL

vs. DPDL) with a follow up to 10 years. The overall implant survival rates were 100% with DPDL compared to 95% with EPDL. No data on marginal bone loss was available for group comparison.

3.1.1.c Delayed implant placement:

Based on two RCTs (108 patients, 108 implants) comparing delayed implants with either immediate or delayed loading (DPIL vs. DPDL), an implant survival rate of 98.1% in both groups was shown. No marginal bone loss analysis could be performed as the data could be attributed to the anterior maxillary region in only one study (60 patients, 60 implants).

Consensus statement:

There is evidence that the different timings for implant placement / loading evaluated in this systematic review presented with high implant survival rates for up to 10 years of follow-up. Marginal bone loss in immediate and delayed implant placement for different timings of loading, have shown to be comparable during this period.

3.1.2 Does the use of a flap vs. flapless procedure affect the implant survival?

Information on flap or flapless surgery was presented in 22 studies (6 RCTs, 10 prospective, 6 retrospective studies, 738 implants) irrespective of timing of implant placement and loading. Implants placed with raising a flap showed a survival rate of 98.1% and flapless placed implants 98.6%.

3.1.3 Does the use of augmentation procedures affect the implant survival?

Pooled data from 25 studies (6 RCTs, 11 prospective, 8 retrospective studies, 802 implants) with an observation period of up to 120 months could be identified where bone augmentation procedures were performed during implant placement. Implants placed immediately in conjunction with or without bone augmentation procedures showed similar survival rates (97.5% and 98.3% respectively). However, the working group suggested that, in general, caution is required when data are pooled from a variety of studies with different designs which may not be comparable.

Information on simultaneous soft tissue grafting was available in 12 studies (4 RCTs, 3 prospective, 5 retrospective studies, 429 implants) with an observation period of up to 60

months. The evaluation of these studies showed a survival rate for non-grafted implants of 98.9% and implants with tissue grafts of 94.9%.

Consensus statement: Based on the available data there is no robust evidence to indicate that the use of bone and/or soft tissue augmentation procedures may affect the survival rate of single tooth replacement in the anterior maxilla in conjunction with different implant timing or loading protocols.

3.2 Clinical recommendations

Different timings of implant placement / loading in relation to tooth extraction / implantation presented high implant survival rates and similar levels of bone loss for single-tooth implants in the anterior maxilla. Taking into consideration, that the current literature does not clearly favour (in terms of implant survival) one specific timing of implant placement / loading over the other, the clinician should consider all relevant biological, anatomical and aesthetic factors prior to the selection of any of these procedures.

3.3 Recommendations for future research

Future research should:

- Define the role of implant surfaces/designs in RCTs in conjunction with different timings in implant placement/loading.
- Evaluate the effect of augmentation procedures in conjunction with different timings in implant placement/loading.

4. Patient's perception of timing concepts in implant dentistry.

4.1 Focused question: “What is the patient's perception of immediate/early implant placement or immediate/early implant loading in comparison with traditional/conventional/delayed placement and/or loading (C), assessed by patient reported outcome measures, as evidenced in randomized controlled clinical trials (RCTs), or prospective controlled studies?”

In the literature, the patient's perception of timing for implant placement/loading is expressed through a variety of validated and non-validated patient reported outcome measures (PROMs). Within the clinical setting, it could be suggested that patients may prefer if the treatment time during implant dentistry procedures is reduced. However, there is no clarity if there is robust evidence supporting this assumption. In the present systematic review (Gotfredsen, Hosseini, Rimborg, Özhayat, 2021), the search strategy initially resulted in 1439 publications, but only 35 studies fulfilled the inclusion criteria and were eligible to be included in the descriptive analyses to answer the following questions set by the working group 1 during the consensus conference.

Partially edentulous patients

4.1.1 What is the patient's perception of different timing protocols for implant placement/loading for implant-supported single crowns and short-span FDPs?

Implant placement time: Nine RCTs (1041 patients) and one prospective cohort study (20 patients) using PROMs, compared immediate vs. early vs. delayed placement with different loading protocols. No studies demonstrated significant differences in patient discomfort or satisfaction. Only one study used PROMs as the primary outcome, whereas it was reported as a secondary outcome in the remaining studies. Four of these studies used simple categorical judgements with dichotomous responses (yes/no) or a 5-point ordinal scale questions. Five studies used a visual analogue scale (VAS) and one study added the Oral Health Impact Profile Questionnaire in the short version (OHIP-14). All studies reported high patient satisfaction (comfort, aesthetic and function) with the treatments irrespective of implant placement time.

Implant loading time: Ten RCTs (483 patients) compared different loading protocols utilizing PROMs. Two RCTs (43 patients) used PROMs as the primary outcome. One split-mouth RCT (30 patients) found that most patients had no preference, but of those that had a preference, more patients preferred immediate than early loading. The remaining studies did not find any

difference. Three prospective cohort studies (234 patients) confirmed this finding, but used the PROMs as a secondary outcome measure. One prospective cohort study (104 patients) used the PROMs as primary outcome measure and included both health status using EuroQoL and oral health related quality of life (OHRQoL) measures. This study found no significant difference in self-rated oral health satisfaction (OSS), but significantly better OHRQoL using the oral health impact profile (OHIP-49) and the oral impacts on daily performance (OIDP) questionnaire in the immediate group compared to delayed loading group.

The hypothesis that patients would prefer immediate implant placement and loading could not be strongly supported by the present literature. This may however, be due to the study designs as most studies were not designed to test that hypothesis.

Edentulous patients

4.1.2 What is the patient's perception of different timing protocols for implant placement/loading for implant-supported full-arch fixed dental prostheses?

Three RCT studies (71 patients) and two prospective cohort studies (63 patients) analysed implant-supported full-arch fixed dental prostheses (FDPs) using PROMs. One RCT found significantly higher patient satisfaction with immediate loading compared to early loading of implant-supported FDPs in the maxilla. Two prospective cohort studies found significantly higher satisfaction with immediate versus delayed loading in both jaws after 3 months, but the difference had disappeared after 12 months. The two remaining RCTs did not find any significant difference at time points ranging from day 1 up to 3 years after baseline assessment. All RCTs used PROMs as a secondary outcome measure, whereas two prospective cohort studies had PROMS as the primary outcome measure using VAS scales for 7 non-validated questions.

There is some evidence that patients are more satisfied with immediate than early and delayed implant loading but the time of assessment may influence the outcome.

4.1.3 What is the patient's perception of different timing protocols for implant placement/loading for implant-supported overdentures?

Five RCT studies (255 patients) and 1 prospective cohort study (49 patients) evaluated implant-supported overdentures using PROMs. Significantly better PROM scores were shown for the immediate compared to early (1 RCT) or delayed loading (1 RCT) group of patients using overdentures in the mandible. In one study, the PROMs was a secondary outcome measure, and a 5-point, non-validated scale was used as PROMs one year after loading. In another study,

PROMs were the primary outcome measure using the oral health impact profile questionnaire for edentulous (OHIP-EDENT) and patient denture assessment (PDA). Significantly more favourable PDA scores and OHIP-EDENT scores were seen at 3 months but not after 4, 5, 6 and 12 months. The remaining 4 studies did not find any significant difference in overall patient satisfaction between immediate and delayed implant placement, but one RCT found significant better patient comfort with the lower denture in the delayed compared to the immediate implant loading group. All included implant-supported overdenture studies using PROMs were performed in the mandible.

The results from the included studies were inconsistent but were characterized by a high overall patient satisfaction with implant-supported overdentures in the lower jaw independent of timing of implant loading.

Consensus statements

Based on the present findings, there is no strong evidence that the timing for implant placement or loading of implant-supported single crowns influences patients' comfort or satisfaction. There is some evidence that patients rehabilitated with full-arch FDPs demonstrate higher patient satisfaction with immediate than with early or delayed loaded implant reconstructions for a period up to 3 months, but the difference is not frequently found 1 year after baseline registration. Patient reported outcome measures evaluating timing for placement/ loading of implant-supported overdentures in the lower jaw showed inconsistent result, but there are RCTs demonstrating more satisfied patients using immediate instead of early or delayed loading.

4.2 Clinical recommendations

The timing protocols including immediate vs. early vs. delayed implant placement/ loading do not appear to have a high impact on patient comfort or satisfaction when evaluated after several months.

4.3 Recommendations for future research

Future research should:

- use PROMs as primary outcome variable.
- develop PROMs with relevant sensitivity/ specificity to detect changes in patient's perceptions in different clinical situations, including aesthetics, surgical discomfort, temporary reconstructions and patient expectations.

- Validate the responsiveness of different PROMS (e.g. OIDP vs. OHIP-14) in different clinical situations.
- construct semi-structured interviews of patients with transcription and text analysis.
- comprise split-mouth studies if possible.
- evaluate the appropriate time points to assess PROMs

Acknowledgement:

The EAO group 1 would like to express their gratitude to the library support that was provided during the consensus conference by Dr Cristina Zarauz, Dept. of Fixed Prosthodontics and Biomaterials, University of Geneva, Switzerland

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