FACULDADE DE MEDICINA
UNIVERSIDADE D
COIMBRA

Integrated Master in Dentistry

DÉBORA MOTA GOMIDE

Patient centered results on oral rehabilitation – Analysis of esthetic factors in randomized clinical trials

Scientific area of
Oral Rehabilitation – Fixed Prosthodontics and Implantology

Work done with the supervision of
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Coimbra, June 2021

"Patient centered results on oral rehabilitation – Analysis of esthetic factors in randomized clinical trials"

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Abstract

Introduction: The smile is of major importance on the overall esthetics of a person and also the most important element of dentofacial esthetics. The goal of this review is to evaluate the esthetic factors determinant for patient satisfaction on anterior oral rehabilitation and how they are reported in randomized clinical trials.

Materials and methods: A review of the literature was performed using the P.I.C.O. search strategy to identify randomized controlled trials presenting esthetic's patient centered outcomes. Two electronic databases were included in the search: Pubmed and Web of Science. After scrutinizing and excluding the articles that did not meet the inclusion criteria 14 studies were included on this review.

Results: Information off all the studies was collected regarding the treatment, follow-up, number of patients included, topic of questions, number of questions, time points and relevant findings. The expressions used on the VAS scales were also analyzed. The randomized controlled trials present objective indexes such as the PES, WES, PES/WES, ICAI, MSI to express the professional opinion and patient-centered indexes such as OHIP-14 and the VAS scale to express the patient opinion.

Discussion: The questions and the methodology applied to the questionnaires differed largely. The results are limited once they represent different treatments outcomes, a disparity on the questionnaires and disagreement between the conclusions. No study presented an open question that could enable the patient to provide more information about the theme. A lack of information regarding a deeper comprehension on patient's perspective is noted across all studies. Factors such as genre, age, social environment, level of education, cultural background and the patient's expectations should be more comprehended and applied to the dental practice, so it makes possible to improve the treatments and meet the specifications of each patient.

Conclusion: Overall esthetic satisfaction and the patient opinion regarding the crown and mucosa are the parameters that are taken more into consideration on the randomized controlled trials analyzed. The patient-centered results tend to be more positive than the professionals'.

Keywords: "Patient-centered results", "esthetics", "anterior maxilla", "oral rehabilitation", "esthetic outcome".

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Abbreviations

ICAI – Implant Crown Aesthetic Index

MSI - Mucosal Scarring Index

OHIP-14 - Oral Health Impact Profile-14

PES – Pink Esthetic Score

PES/WES – Pink Esthetic Score and White Esthetic Score

WES – White Esthetic Score

Introduction

Esthetics is a concept that is specifically used to define beauty and its attributes. It is also aimed to be achieved by most of the humankind. In society, esthetics is an important part of people's lives once it affects both the quality of life and wellbeing of the great majority of people in modern civilization (1,2).

The face is a region of the human body that has the biggest impact in the physical attractiveness of a person (3,4). The smile and teeth are the second most notorious characteristics of a person's face with regard to attractiveness, just followed by the eyes (3,4). Therefore, once the mouth is one of the centers of attention of the face, the smile is of major importance on the overall esthetics of a person and also the most important element of dentofacial esthetics (1). Harmony, symmetry, balance and proportion are fundamental components of an esthetical human being (5,6).

In conclusion, all the data tends to the supremacy of smile in the context of overall facial esthetics (1). Dental professionals should be careful when conducting treatments that could influence smile esthetics (4).

Dental esthetics is a significant reason that make patients attend to dental care in order to achieve a personal upgrade (1,2,7). Until now, there are no objective criterions that connect the patients' esthetic goals with the professional's objectives when conducting an oral rehabilitation treatment on the anterior sector of the maxilla (5,6).

Oral rehabilitation on the anterior sector must achieve simultaneously function, health, longevity and esthetics (7). The esthetic outcome of a smile is the most difficult factor to be qualified once it is composed by a subjective nature (5,7).

The term "oral rehabilitation" is often used by the dental professionals in order to define a range of treatments, biomedical operative processes such as the complex restoration of the teeth and/or the dental arch (8,9). Oral rehabilitation is also defined as the treatment of injured or disabled patients with the goal to restore normal oral health and function or preventing the disability from getting worse (8).

Over the last decades, new developments were geared towards increasing oral rehabilitations' success and survival rates, as well as improving patient satisfaction and quality of life (10).

The esthetic appearance is of great importance when measuring the success of a rehabilitation on the anterior zone of the maxilla (5). When aiming to achieve an esthetic improvement in oral health, several procedures of oral rehabilitation may have been considered and conducted, ranging from conservative to relatively radical (9).

For the great majority of dentists, measurements that are composed by objective and quantifiable components are the conventional signs that define a successful or unsuccessful esthetic rehabilitation (11). Therefore, once esthetics itself is composed by subjective criteria, researchers have tried to define it by objective judgments using indexes (5).

Several new indexes have been presented and tested with the goal of creating a standardized system of esthetic evaluation (5). Although the frequent use of numerous indices for the esthetic evaluation of dental rehabilitation in the anterior region, there is no universally approved or accepted index available in the current literature (5).

When the goal is to achieve esthetic outcomes, some references and parameters must be followed (1). In the past, the guidelines for achieving esthetic results would be based on expert's opinions and the personal and subjective opinions of the authors (1,4). Nowadays, there is still a lack of specific guidelines to achieve esthetical results on an oral rehabilitation which turns it into as a complicated treatment (4).

The evidence and information provided by the esthetic guidelines these days are still questionable, since esthetic is an individual notion that tends to vary among different human beings and cultures (1,4,5). In order to achieve scientific and objective conclusions, digital imaging technology is being used in current scientific studies (1).

Traditionally, the great majority of reports on oral rehabilitation on anterior maxilla have focused on implant success mainly, followed by complications and soft tissue esthetics; and to a lesser extent on patient-based outcomes (12). To better understand the patient perspective on this subject, a patient centered outcome analysis is needed (12).

The quality of the health care perceived by the patient is of timely significance and has become an important outcome in its own right (13). Nowadays, there has been a re-focus on health care from the outcome of patient satisfaction to better understand patient expectations and experiences (14).

There has been a growing need to improve the quality of health care, so in 2001 the Institute of Medicine defined six domains which describe the objectives for improving health care in the 21st century: Safe; effective, patient-centered, timely, efficient and equitable (15). These six dimensions have been accepted internationally and worldwide. (13)

The Patient-centered component of the health care quality aims to provide care that is respectful of and responsive to the individual preferences of each patient, such as its needs and values, and to ensure that the patient's values guide all the clinical decisions (16).

Therefore, in order to increase the quality of health care, patients should be informed and decision makers in their care which means that they should be considered as an experiencing individual and not only an object of the disease (17). The services provided

should be compassionate, empathetic and responsive to the needs, values and preferences of each individual (17).

Patient-reported outcome measures were previously developed to better understand the treatment effectiveness, and now are increasingly being used in clinical practice to monitor and improve the care for individual patients (18).

Patient-Centered outcome measures is also known in the literature as “patient report outcome measures” (PROMs), “patient experience measures” (PREMs), “patient satisfaction”, “patient-centered care” (PCC) and “patient perspective” (17,19).

Accordingly to this approach to health care, it is now possible to measure data from patient’s perspective, and also enable health-related feeling, and goals to be evaluated (19). This information is relevant to dental clinical trials such as esthetics and satisfaction concerning dental treatments (19).

There is a need to combine the evaluation of the professional (objective) and the patient (subjective) (5). The combination of the results of the patient’s and professional’s would not only establish the degree of the agreement or disagreement between the two perspectives, but would also create information to guide the dentist by parameters approved by the patients in order to achieve a more adequate and overall attractive dental rehabilitation (5).

On this review, randomized clinical trials will be analyzed, so a better understanding of the theme can be achieved.

A randomized controlled trial is a prospective, comparative and quantitative study performed under controlled conditions (20). This type of clinical trial is becoming increasingly popular in all areas of clinical medicine, including dentistry (21).

The randomized controlled trial is the most rigorous and robust research method to measure the effectiveness of an intervention or treatment (20,21). This type of study determine whether a cause-effect relation exists (20).

Randomized controlled trials (RCT) are accepted as the best method for studying the efficacy of a new treatment due to the leverage presented by randomization (22). High-quality evidence can be obtained by conducting a randomized controlled trial (20). It is a strong foundation for synthesizing the data obtained and to conduct the formulation of systematic reviews and meta-analysis (20).

The participants in randomized controlled trials are divided in groups and are allocated randomly to compare the results of the interventions (20). Randomization reduces bias, including selection bias, and provides a rigorous tool to examine the cause-effect between an intervention and the outcome (21).

This review will analyze data collected only on randomized controlled trials in order to provide a review based on solid and up-to-date information.

Nowadays, a method which is capable of evaluate the esthetic result of oral rehabilitations that is as far as possible objective, complete, reliable, reproducible, and free from methodological errors or bias is still unknown (5). There are a wide variety of articles studying esthetics on the anterior sector, and it is of predominant importance to achieve measurable, simple and practical results which could be arranged into protocols to be used by dental professionals (1).

Interdisciplinary treatment, teamwork and a comprehensive management is of major importance when achieving and ideal rehabilitation of the smile with a satisfactory esthetic outcome (1,2).

The question of how to create a smile which could provide the best esthetic outcome for the patient remains.

The goal of this review is to evaluate the esthetic factors documented on the randomized controlled trials and to conduct an analysis of the factors that have a major impact on regard to patient satisfaction. The objective is to create awareness and improve the knowledge regarding this complex subject for future investigations.

Materials and Methods

A review of the literature was performed to identify randomized controlled trials published in English or Portuguese presenting esthetic's patient centered outcomes.

The P.I.C.O. (Patient or population, Intervention, Control or Comparison, Outcome) search strategy was conducted.

Two electronic databases were included in the search: Pubmed and Web of Science.

An electronic search was conducted on the databases to identify clinical randomized controlled trials published until May 2021. The search terms and algorithm were modified according to the specific guidelines of each database.

P.I.C.O

The focused leading question was set according to the P.I.C.O. model for clinical questions.

The P.I.C.O. model including the four criteria were as follows:

P (population)	Dental partial edentulous patients on the anterior sector.
I (Intervention)	Implant supported rehabilitation (unitary or partial).
C (Comparison)	Natural tooth on the anterior zone of the maxilla.
O (Outcome)	Esthetic reported outcome based on patient perspective (criterions, analyzed data and methodology used).

The resulting P.I.C.O. question was: In partially edentulous patients on the anterior sector of the maxilla, what are the patient centered esthetic factors reported by the patients in randomized controlled trials?

Search

A general search strategy was developed using the following keywords adapted to the specific database:

Database	Search Strategy
Pubmed	((Patient-Centered Care[MeSH Terms]) OR (Patient Satisfaction[MeSH Terms]) OR (Patient Outcome Assessment[MeSH Terms]) OR ("patient-reported outcome measures") OR ("Patient-Centered Outcomes") OR ("patient satisfaction") OR ("patient based") OR ("patient centered") OR ("satisfaction index") OR ("patient perspectives")) AND ((Dental Prosthesis[MeSH Terms]) OR ("dental rehabilitation") OR ("dental implant*") OR (prosthesis) OR (prosthetic*) OR ("oral rehabilitation")) AND ((Esthetics, Dental[MeSH Terms]) OR ("esthetic score*") OR ("esthetic index") OR (esthetic*) OR ("visual analog scales")) AND ((Maxilla[MeSH Terms]) OR ("anterior area") OR ("esthetic zone") OR ("esthetic Area*") OR ("anterior maxilla"))
Web of Science	TS= ((("Patient* Center* Care*") OR ("Patient* satisfaction*") OR ("patient reported outcome measures") OR ("Patient Center* Outcomes") OR ("patient base*") OR ("satisfaction index")) AND (("Dental Prosthe*") OR ("dental rehabilitation") OR ("dental implant*") OR ("prosthesis") OR ("prosthetic*") OR ("oral rehabilitation")) AND (("Esthetic*") OR ("esthetic score*") OR ("esthetic index") OR ("visual analog scales")) AND (("Maxilla*") OR ("anterior area") OR ("esthetic zone") OR ("esthetic Area*") OR ("anterior maxilla"))) AND TI= ("randomized controlled trial")

Study selection

After rigorous consideration, a list of inclusion and exclusion criteria was originated.

Inclusion criteria	• Human clinical studies • Randomized controlled trials • Partially edentulous patients on the anterior sector • Documentation of esthetic patient centered results on esthetics • Publication in Portuguese or English
Exclusion criteria	• In vitro or animal studies • Study Protocols, cohort studies, case reports, reviews (narrative and systematic) • Total edentulous patients • Partial edentulous patients on the mandibula or on the posterior zone of the maxilla • Removable partial dentures • Fully dentate patients • Dental composite restorations • Orthodontic studies • Studies not written in Portuguese or English

All databases were scanned for the keyword mentioned and for related literature.

Additionally, related articles with similar topics were handsearched and screened, in order to find relevant articles. All the relevant articles included on this search were added to the results of the electronic search.

After the elimination of duplicates, the titles of the remaining articles were analyzed for adequacy, according to the inclusion criteria.

The articles' examination was firstly performed on the titles, then on its abstract and lastly a full text read was conducted. All the articles that met the inclusion criteria passed to the next phase of the examination. All the articles which did not meet the inclusion criteria were excluded. Whenever the relevance of the study was indecisive, it would be included in the next step of the analysis.

After reviewing the full texts, irrelevant articles and the ones who did not meet the goal of the investigation were excluded, and data from the remaining articles were extracted. A total of 14 studies were included on this review.

Results

The scrutiny of the 14 selected articles of this review revealed different esthetic parameters that are compared and studied.

An analysis was made on these clinical trials with the objective of comprehending the esthetic assessment realized including the objective and subjective parameters used and its applications to dental rehabilitations on the anterior sector of the maxilla.

In **table 1** it is possible to access the title, year of publication, follow-up, number of included patients and the indexes used.

The number of included patients mentioned on the **table 1** correspond to the number of patients who attended to the last follow-up visit of each study regarding the esthetic assessment. The initial number of patients enrolled in the study and the ones who were excluded, did not attend the questionnaire and the dropouts of each study were not taken into consideration. The reasons of the dropouts and how it prevented the participants to attend to the final follow-up visits are not considered relevant to this review, so the data was not analyzed.

The articles included in this review used known indexes to analyze the patient centered outcome and the esthetic results. The indexes used include the PES, WES, PES/WES, ICAI, MSI, OHIP-14 and the VAS scale. The comprehension of these indexes is relevant once it correlates the patients' satisfaction with the professionals' and promotes a comparison between the esthetic results. To better comprehend the actual contrast between esthetic and its objective and subjective segments, a comparison between the values of the studies regarding each perspective is important to be conducted. With this goal, the relevant findings regarding this theme are found in **table 1**.

The indexes used were:

ICAI

The ICAI – Implant Crown Aesthetic Index uses as a reference tooth the contralateral and adjacent tooth to evaluate the index. (23)

The four criterions of the peri-implant mucosa present o the ICAI are the labial margin, papillae, contour of the labial surface and the color and surface (24). Width, length, labial convexity, color/translucency, and surface are the five factors analyzed about the implant crown (25).

Each parameter can assume values from 0 to five in which the five is the worst value of the scale, with a total score of 45 in the worst case (24). The **figure 1** represents the ICAI index and its criterions.

	ICAI[13]
Criteria of the peri-implant mucosa (pink esthetic)	Labial margin Papillae Contour of the labial surface Colour and surface
Criteria of the implant crown (white esthetic)	Width Length Labial convexity Color/translucency Surface
Subjective overall criteria	None
Reference tooth	Contralateral and adjacent tooth
Scores per criteria	0 (No deviation) 1 (Small deviation) 5 (Large deviation)
Overall score	0–45 Points
Threshold of clinical acceptability	<5 Points

Figure 1- ICAI Index Parameters (24)

PES/WES

The Pink Esthetic Score and the White Esthetic score are used to evaluate the pink (PES) and the white (WES) of single implants rehabilitation by comparison with a contralateral tooth (26). The PES and WES can be used separately. It analyses 5 parameters about the peri-implant mucosa and 5 parameters about the implant crown (25).

The Pink esthetic parameters comprehend the mesial papilla, distal papilla, facial curvature, level of facial mucosa and root convexity and color (24).

The five of the factors analyzed on the WES is the tooth form, outline/volume, color, surface texture, translucency and characterization (24).

This index assumes that each parameter can be evaluated from 0 to 2 in each the number two is the absence of deviation. The best score of the index is 20 (24). To better comprehend this index, consul the parameters used (**figure 2**).

PES			
Parameter	Absent	Incomplete	Complete
Mesial papilla	0	1	2
Distal papilla	0	1	2
	Major Discrepancy	Minor Discrepancy	No Discrepancy
Curvature of facial mucosa	0	1	2
Level of facial mucosa	0	1	2
Root convexity/soft tissue color and texture	0	1	2
Maximum total PES score			10

WES			
Parameter	Major Discrepancy	Minor Discrepancy	No Discrepancy
Tooth form	0	1	2
Tooth volume/outline	0	1	2
Color (hue/value)	0	1	2
Surface texture	0	1	2
Translucency	0	1	2
Maximum total WES score			10

Figure 2 - PES/WES Index (27)

MSI

The MSI - Mucosal Scarring Index is an index that scores the presence or absence of scars after surgical procedures (28). This scale can be used as and complement to other indexes in the evaluation of esthetic treatments (29). It is ranked from 0 to 10 as 0 meaning no scar and the 10 meaning the most extreme scar (29). The scars categories and respective points are present in **figure 3**.

	Scar category	Points
Width	> 1 mm	2
	≤ 1 mm	1
	0 mm	0
Height/contour	Hypertrophic or invaginated	2
	Slightly hypertrophic or invaginated	1
	Flush with surrounding mucosa	0
Color	Obvious mismatch	2
	Slight mismatch	1
	Perfect	0
Suture marks	Clearly visible	2
	Slightly visible	1
	Absent	0
Overall appearance	Poor	2
	Acceptable	1
	Good	0

Figure 3 – Parameters of the MSI Index (29)

OHIP-14

The OHIP-14 – Oral Health Impact Profile-14 can assess the health-related quality of life (30). It is a practical instrument to apply in epidemiological surveys and clinical practice (31).

It is composed by 14 questions that are scored from 0 to 5 (30). The score of zero refers to a good quality of life while the 5 represents the worst. In total the score may vary from 0 to 70 (30). The main domains and its questions are present below on **figure 4**.

Domain	Item
Domain 1: Functional limitation	1. Had trouble pronouncing any words 2. Felt sense of taste has worsened
Domain 2: Physical pain	3. Had painful aching 4. Found it uncomfortable to eat any foods
Domain 3: Psychological discomfort	5. Been self-conscious 6. Felt tense
Domain 4: Physical disability	7. Felt diet has been unsatisfactory 8. Had to interrupt meals
Domain 5: Psychological disability	9. Found it difficult to relax 10. Been a bit embarrassed
Domain 6: Social disability	11. Been a bit irritable 12. Had difficulty doing usual jobs
Domain 7: Handicap	13. Felt life less satisfying 14. Been totally unable to function

Figure 4- OHIP-14 Questionnaire (32)

Visual Analog Scale

The VAS - Visual Analog Scale is a method which clinicians and epidemiologists use to evaluate subjective parameters and phenomenon such as pain, esthetics, itching intensity, and different sensations experienced by the individuals who are answering the questionnaire (33).

Various methods have been used in order to rate the esthetic preferences on dentofacial structures (34). The VAS has a long history of being used in health outcome studies since it was first published in the early 1920's (35).

The goal of this measurement is to transform perceptions or sensations of individuals into data that can be analyzed and processed accordingly (34). Therefore, it becomes possible to turn the perspective of the patient into parameters that the dental professional can work with to better understand the patient's viewpoint (36).

This method is recommended as a subjective measure used in esthetic outcome of implant supported treatments (36). This measurement instrument is especially important in questionnaires about characteristics that are believed to vary across continuum values and may not be directly measured (36).

It presents advantages such as the affordable cost, convenience, fast speed, adaptability and trustworthy of the method (34). Due to its simplicity and the ease to eliminate language barriers, it presents an asset to compare results by the use of statistical analysis (36).

The evaluation carried about the patient satisfaction and quality of their lives may increase the success of dental implant treatments (37).

The main disadvantages presented by this tool is the fact that the individuals who answer the questionnaire tend to spread their responses through the entire scale, avoiding the extremities of the anchor points, not considering their real preference (34). Additionally, a uniform and equal response to the entire scale can be difficult to be achieved (34).

The VAS consists of an absolute method which rates each object relatively independently and reduces the confounding effect between individuals who misinterpret the graduations and don't consider that their response corresponds with the numeric or rating scales (34,35). Once the results originated by the VAS are ordinal, it is by itself a reason why it can and should be statistically analyzed (35).

It may be presented in different formats, varying into horizontal and vertical lines. It is most commonly presented as a single line of 100 mm with anchor words in both extremities, but the length presented can change either (35). Once the anchor words of the analyzed studies presented differences, the expressions used in each extremity of the scale are mentioned in **table 3**.

To better comprehend how this scale is presented on the questionnaires, an example of the VAS scale and its appearance is found below (**figure 5**).

Figure 5 - Example of a Visual Analog Scale (38)

Table 1 - Data of the studies included (title, treatment, patient number, follow-up, indexes used).

Autor	Title	Treatment	Patient nº	Follow-up	Indexes
Meijndert, et al. 2007 (23)	"Evaluation of aesthetics of implant-supported single-tooth replacements using different bone augmentation procedures: A prospective randomized clinical study"	G1: chin bone (n=31) G2: chin bone + Bio-Gide GBR-membrane (n=31) G3: Bio-Oss spongiosa granules + Bio-Gide GBR membrane (n=31)	91	1 year	ICAI VAS
Den Hartog, et al. 2011 (25)	"Immediate non-occlusal loading of single implants in the aesthetic zone: A randomized clinical trial"	G1: immediate restoration with non-occluding temporary crown within 24 hours (n=31) G2: conventional restoration according to a two-stage procedure after 3 months (n=30)	61	18 months	PES/WES ICAI VAS
Gallucci, et al. 2011 (26)	"Esthetic outcomes with porcelain-fused-to-ceramic and all-ceramic single-implant crowns: A randomized clinical trial"	G1: porcelain-fused-to-ceramic (n=10) G2: all-ceramic (n=10)	17	2 years	PES/WES VAS
Albornoz, et al. 2014 (39)	"A randomized trial on the aesthetic outcomes of implant-supported restorations with zirconia or titanium abutments"	G1: titanium (n=14) G2: Zirconia (n=11)	25	1 year	ICAI VAS
Esposito, et al. 2015 (40)	"Immediate non-occlusal loading of immediate post-extractive versus delayed placement of single implants in preserved sockets of the anterior maxilla: 1-year post-loading outcome of a randomised controlled trial"	G1: immediate implant placement (n=52) G2: delayed implant placement (n= 46)	98	1 year	PES
Nimwegen, et al. 2015 (41)	"Treatment Outcome of Two Adjacent Implant-Supported Restorations with Different Implant Platform Designs in the Esthetic Region: A Five-Year Randomized Clinical Trial"	G1: scalloped implant (n=16) G2: flat implant (n=19)	35	5 years	ICAI

Sanz, et al. 2015 (42)	"Clinical and radiologic outcomes after submerged and transmucosal implant placement with two-piece implants in the anterior maxilla and mandible: 3-year results of a randomized controlled clinical trial"	G1: submerged treatment group (n=54) G2: transmucosal healing group (n=52)	106	3 years	-
Slagter, et al. 2016 (31)	"Immediate Single-Tooth Implant Placement in Bony Defects in the Esthetic Zone: A 1-Year Randomized Controlled Trial"	G1: immediate implant placement (n=20) G2: delayed implant placement (n=20)	40	1 year	PES/WES ICAI OHIP-14 VAS
Den Hartog, et al. 2017 (43)	"Anterior single implants with different neck designs: 5 Year results of a randomized clinical trial"	G1: smooth neck (n=26) G2: rough neck with grooves (n=28) G3: scalloped rough neck with grooves (n=26)	80	5 years	PES/WES VAS
Gjelvold, et al. 2017 (44)	"Clinical and radiographic outcome following immediate loading and delayed loading of single-tooth implants: Randomized clinical trial"	G1: immediate loading (n=25) G2: delayed loading (n=24)	49	1 year	PES/WES OHIP-14 VAS
Patil, et al. 2017 (45)	"Esthetic Evaluation of Anterior Single-Tooth Implants with Different Abutment Designs—Patients' Satisfaction Compared to Dentists' Observations"	G1: divergent abutment design (n=26) G2: curved abutment design (n=26)	26	1 year	PES VAS
Jonker,et al. 2018 (46)	"The effect of resorbable membranes on one-stage ridge augmentation in anterior single-tooth replacement: A randomized, controlled clinical trial"	G1:one- stage ridge augmentation with membrane (n = 25) G2: without use of a membrane (n = 26)	51	1 year	PES/WES VAS
Huynh-Ba, et al. 2019 (47)	"Esthetic, clinical, and radiographic outcomes of two surgical approaches for single implant in the esthetic area: 1-year results of a randomized controlled trial with parallel design"	G1: immediate implant placement (n=20) G2: early implant placement (n=15)	35	1 year	PES/WES VAS
De Bruyckere, et al. 2020 (28)	"A randomized controlled study comparing guided bone regeneration with connective tissue graft to re-establish buccal convexity: One-year aesthetic and patient-reported outcomes"	G1: guided bone regeneration - GBR (n=21) G2: connective tissue graft - CTG (n=21)	42	1 year	PES/WES MSI VAS OHIP-14

Only one of the studies conducted the insertion of two implants per patient (45). This study included 26 patients with nonadjacent missing teeth in the anterior zone of the maxilla between the second premolar of each side. All the remaining studies or clinical trials treated only one edentulous tooth per patient on the anterior area of the maxilla with implant supported oral rehabilitation (45).

Only one article included implants in the maxilla and in the mandible in which only 14 of the 106 cases were in the mandible (1). The results regarding this article were included due to the small number of the cases in the mandible and the relevance of the findings. Unfortunately, the article did not present distinguished results for both locations which led to a limitation of this review.

Data regarding objective parameters that were not considered important for the theme and the question of the review were not included in this paper. Such data includes probing depth, survival rates, marginal bone loss, insertion torque, biological or biomechanical complications, bleeding, and probing. Therefore, no evaluation of these parameters occurred.

The information regarding the esthetic opinion of the patients was collected by questionnaires. The questionnaires addressed to the patients about their feelings and opinions regarding the esthetic result of their oral rehabilitation are central pillars of this investigation. By analyzing the questionnaires, is possible to understand how this theme is being studied across all the studies and helps to interpret the answers provided to the questions.

On **table 2** is possible to find the questionnaires used on each study, the topic of the questions asked to the patients, the moment when the questionnaires were assessed (“Time points”), the number of questions present in each questionnaire, the questions asked to the patients, and the relevant findings of each article.

On this review the type of questionnaire and the moment when it was conducted (time point) were considered to allow better understanding and comprehension of their use. However, information regarding the way that the questionnaires were conducted are not present on every study.

The Time Points had in consideration the delivery of the definitive crown to start the counting time in all of the studies, except for one article that measured the time by the surgical procedure (28).

On Patil’s, 2017 (45) article participants answered the questionnaire which were accompanied by simple and precise instructions, after looking in the mirror and viewed a photograph of themselves with the final treatment.

At the investigation conducted by Bruyckere, 2020 (28) patients were informed after surgery of the self-assessment questionnaire with the VAS scale and the instructions were

repeated by a nurse at the scoring time. The surgeon was not present when the patients answered the VAS scale in order to reduce bias.

Esposito et al.(40) stated that the patient satisfaction registration was conducted by a local blind assessor who provided a mirror to the patient showing the crown on which patients were asked about; the questions were posed with the exact same wording. The article of Albornoz, 2014 (39) mentioned that the questionnaire was written instead.

In The article of Sanz et al. (42) the patients answered the questionnaire in the presence of the investigator which was responsible for the assessment of the patient's satisfaction regarding the final restoration.

No information regarding the methods and details of the way the questionnaires were conducted have been mentioned on the remaining studies.

Even though the OHIP-14 questionnaire is directed to the patient perspective, since it is already a standardized index, it has not been added to the **table 2**.

All the included studies of this review used one or more questionnaires in which several questions were formulated. Patient-centered results regarding esthetic are the center of this review but once some of the articles correlated the esthetic factors with other parameters assessed on the questionnaires such as pain, swelling, impact of the surgery, functionality and comfort, an inclusion of this information was also made on **table 2**.

Table 2 - Patient-centered questionnaires

Autor	Questionnaire	Topics	Time Points	Nº of questions	Questions	Relevant Findings
Meijndert, et al. 2007 (23)	Visual Analog Scale	Overall satisfaction score	1 year	-	-	-Significant correlation between the opinion regarding the peri-implant mucosa from patients and dentists. -Hardly any correlation among the opinion of professionals and patients on the aesthetics. -No significant correlation regarding the overall score and crown score. -Patients' opinion was more positive than professionals'. -The peri-implant mucosa was graded as less satisfactory than the implant supported crown by both dentists and patients. -Severe bone deficiency in all cases led to the necessity of a local bone augmentation in a separate session. -Less satisfactory results were stated by dentists on the total result and on the crown results. -No significant correlation about the method of bone augmentation, position of the implant, gender, and age.
	Questions concerning the crown and the peri-implant mucosa (score 0–1)	Crown score Mucosa score				

Autor	Questionnaire	Topics	Time Points	Nº of questions	Questions	Relevant Findings
Den Hartog, et al. 2011 (25)	Visual Analog Scale	Overall satisfaction	6 months 18 months	1	-	-Hight patient satisfaction in both study groups. -No differences were detected in both study groups on the patient satisfaction. -One third of patients mentioned the healing time was long from the conventional study group, on both visits of the follow-up.
	5-poin rating scale ‘‘satisfied’’ versus ‘‘not satisfied’’ and ‘‘in agreement’’ versus ‘‘not in agreement’’	**Aesthetics:** -color of the crown; -form of the crown; -color of the mucosa around the crown; -form of the mucosa around the crown **Function**: -eating, -speaking **Treatment procedure:** -healing time of the implant; -like or dislike the visits to the dentist to make the crown; -regret that the choice of treatment; -Recommend the treatment to others		-		

Autor	Questionnaire	Topics	Time Points	Nº of questions	Questions	Relevant Findings
Gallucci, et al. 2011 (26)	Visual Analog Scale	Overall satisfaction with the esthetic outcome	From 2 weeks up to 1 month after crown insertion 1 year 2 years	-	-	- No differences between the PES of both groups. - PES values were higher than WES in both groups. - No statistical differences between the patients' esthetic satisfaction on both groups. - Results indicate differences in the aesthetic assessment from professionals and patients. -Subjective evaluation of experts did not show clinical differences between groups. -The restorations of both groups were indistinguishable between each other, objectively and subjectively regarding esthetic.
Albornoz, et al. 2014 (39)	Visual Analog Scale	Esthetic satisfaction	1 month 1 year	-	-	-High patient's satisfaction score in all cases (VAS and questionnaire results). -Low esthetic outcome measured by calibrated examiner. - Better results regarding esthetics in the zirconia group.
	6 grade scale (extremely negative – extremely positive)	Aesthetic appearance Phonetic ability Overall satisfaction with the treatment.				

Autor	Questionnaire	Topics	Time Points	Nº of questions	Questions	Relevant Findings
Esposito, et al. 2015 (40)	5 points questionnaire ('yes absolutely', 'yes partly', 'not sure', 'not really' and 'absolutely not')	Function Aesthetic outcome	4 months 1 year	2	'Are you satisfied with the function of your implant-supported tooth?' 'Are you satisfied with the aesthetic outcome of the gums surrounding this implant?'	- All patients stated absolutely satisfaction with both function and aesthetics at all follow up visits. - All patients stated they would repeat the same procedure in both follow up consults. - No statistically difference between the PES scores of the groups. - Presence of more complications for immediate post-extractive implants.
	Yes or no question	Repeat the procedure		1	"Would you undergo the same therapy again?"	
Nimwegen, et al. 2015 (41)	Questions concerning the crown and the peri-implant mucosa (score 0–4)	Color of the Crown Color of mucosa, Shape of crown Shape of mucosa	1 year 5 years	-	-	-Patient satisfaction concerning the esthetic outcome was very high. -Dentists rated most of the cases as having poor esthetics without significant differences between them.
	Question (range 0-10)	Overall satisfaction				
Sanz, et al. 2015 (42)	4 scores questionnaire (excellent, good, fair, and poor)	Comfort, Appearance, Ability to chew, Taste, Fit of the restoration	1 year 2 years 3 years	-	-	-No patient of the study rated any category as poor. -Highest score was given in comfort in both groups.

Autor	Questionnaire	Topics	Time Points	Nº of questions	Questions	Relevant Findings
Slagter, et al. 2016 (31)	Visual Analog Scale	Overall satisfaction	1 month 1 year	-	-	-No differences were observed on the OHIP-14 values between both groups during the entire follow-up. -No significant differences were found between ICAI and PES/WES in both groups. -The esthetic outcome did not differ between groups and was mainly dependent on the crown than of the peri-implant mucosa.
Den Hartog, et al. 2017 (43)	Visual Analog Scale	Overall satisfaction	5 years	-	-	-No differences found regarding the overall patients' satisfaction. -No difference in treatment outcome was found between the smooth and rough neck design groups. -No significant differences regarding the esthetics of the mucosa and the crown were found.
Gjelvold, et al. 2017 (44)	Visual Analog Scale	Aesthetics satisfaction	1 year	1	"Are you satisfied with the aesthetic result of your treatment?"	-Considered degree of correlation between the satisfaction score on VAS, PES/WES and OHIP-14 scores. -There was a moderate correlation between the OHIP-14 and the VAS score, indicating that low patient quality of life affects the perception of aesthetics negatively. -Very weak correlation was found between VAS the PES/WES scores.

Autor	Questionnaire	Topics	Time Points	Nº of questions	Questions	Relevant Findings
Patil, et al. 2017 (45)	Visual Analog Scale	Functionality Esthetic point of view	0 months 1 year	3	"How good looking are your implant teeth now, as compared to neighbouring natural teeth?" "How good are they in function as compared to neighbouring natural teeth?" "How good do the gums around your implant crown look, as compared to neighbouring teeth?"	-High correlation between all PES score and VAS results, but low coefficients on the correlation. -Satisfaction regarding muco-gingival conditions was high according to professionals and patients. -The curved experimental abutment did not present any difference in both groups regarding esthetics measured by patients and dentists.
Jonker,et al. 2018 (46)	Visual Analog Scale	Overall satisfaction with the dentition Impact of the surgery Pain Swelling Satisfaction with the crown and soft tissue	Preoperative 1 month 6 months 1 year	-	-	-High patient satisfaction regarding dentition, crown, and soft tissues in both groups. - No difference found between patient satisfaction and overall esthetic results. -No severe subjective complaints as pain were stated. -Patient's overall satisfaction did not differ significantly between groups. -PES and WES scores were not significantly different when comparing the groups. -No significant difference perceived on the impact of surgery, pain or swelling. -The use of the membrane led to more bony and mucosal dehiscences, less marginal bone loss and higher bleeding scores.

Autor	Questionnaire	Topics	Time Points	Nº of questions	Questions	Relevant Findings
Huynh-Ba, et al. 2019 (47)	Visual Analog Scale	Satisfaction-Timing Satisfaction-appearance Level of pain Level of swelling	3 months	-	-	- High patient satisfaction with the implant crown esthetics - High level of satisfaction in both procedures - No different on both abutment designs with respect to gingival esthetics assessed by the PES and VAS score.
	Yes or no questions	Speech affect Eating affected				
De Bruyckere, et al. 2020 (28)	Visual Analog Scale (no pain/oedema/haematoma,severe pain/oedema/haematoma)	Pain	1,2,3,7 and 14 *	-	-	-There was no significant difference in the outcomes of the esthetical results between groups. -Both procedures were well tolerated once patients were willing to undergo the same therapy again. (91% in the control group and 81% in the test group) -More painkillers were taken in the control group due to scaring and discomfort. -Bleeding and haematoma were reported more in the control group.
		Oedema Haematoma	1,3 and 7 days *			
	Visual Analog Scale	Aesthetic outcome of the soft tissues Aesthetic outcome of the crown	1 year*	2	"How satisfied are you with the aesthetic outcome of the soft tis- sues surrounding the implant?" "How satisfied are you with the aesthetic outcome of the crown?"	
	Yes or no answer or a numeric answer	Number of painkillers Post-op bleeding	2 weeks*	-	-	
	3 scores questionnaire (no, maybe, yes)	Undergo the same therapy again				

** Time after surgery*

On the table below, (**table 3**) it is possible to find the results from the expressions present on the extremities of the VAS scales of the randomized clinical trials included on this review. This data is relevant once it represents the differences found regarding the terms and the esthetic definitions of each article and how it can have an impact on the answer of the patient.

Table 3- Extremities expressions of the VAS scale

Autor	Left extremity of the VAS scale	Right extremity of the VAS scale
Meijndert, et al. 2007 (23)	0	10
Den Hartog, et al. 2011 (25)	Very dissatisfied	Very satisfied
Gallucci, et al. 2011 (26)	Not satisfied at all	Fully satisfied
Albornoz, et al. 2014 (39)	-	-
Esposito, et al. 2015 (40)	Did not use VAS	Did not use VAS
Nimwegen, et al. 2015 (41)	Did not use VAS	Did not use VAS
Sanz, et al. 2015 (42)	Did not use VAS	Did not use VAS
Slagter, et al. 2016 (31)	0	10
Den Hartog, et al. 2017 (43)	Very dissatisfied	Very satisfied
Gjelvold, et al. 2017 (44)	Not at all satisfied	Very satisfied
Patil, et al. 2017 (45)	Much less than natural teeth	Much more than natural teeth
Jonker,et al. 2018 (46)	0	10
Huynh-Ba, et al. 2019 (47)	Not satisfied	Completely satisfied
De Bruyckere, et al. 2020 (28)	Most unsatisfied	Most satisfied

The results regarding the esthetic satisfaction of the patient on each study is presented on the **table 4**. The results found on **table 4** represent the results of the most important questions of the questionnaires present on **table 2**.

Table 4 - Patient satisfaction scores

Autor	Patient esthetic satisfaction
Meijndert, et al. 2007 (23)	-82% of the patients were totally satisfied about the crown. -43% of the patients were totally satisfied about the mucosa. -Mean overall score of 8.5 on VAS scale with an acceptable result in all cases (100%).
Den Hartog, et al. 2011 (25)	-Patient satisfaction with color of the crown varied from 93 % to 100%. -Patient satisfaction with form of the crown varied from 93% to 100%. -Patient satisfaction with color of the mucosa around the crown varied from 87% to 97%. -Patient satisfaction with form of the mucosa around the crown varied from 80% to 87%. -General satisfaction with VAS score varied from 89 to 91,5.
Gallucci, et al. 2011 (26)	-The VAS score was of 91,81 +/- 5,94 on the porcelain-fused-to-ceramic group and 91,78 +/- 10,04 on the all-ceramic group on the two year follow-up visit.
Albornoz, et al. 2014 (39)	-VAS score of 8,5 in both groups.
Esposito, et al. 2015 (40)	-51 patients were absolutely satisfied, and one was partially satisfied from the immediate group regarding function and esthetics. - 48 patients of the delayed group were absolutely satisfied, and one partially satisfied from the delayed group regarding function and esthetics.
Nimwegen, et al. 2015 (41)	-Mean overall scores were 8,4 for the scalloped group and 9,1 to the flat group. -Overall satisfaction score ranked from 0 to 10 was of 8,3 +/- 1,2 on the scalloped group at 1 year and 8,4 +/- 1,7 after 5 years. -Overall satisfaction score ranked from 0 to 10 was of 8,6 +/- 0,8 on the flat group at 1 year and 9,1 +/- 0,8 after 5 years.
Sanz, et al. 2015 (42)	-Patient satisfaction was good to excellent in more than 90% of the participants in both treatment groups for all the categories, after 3 years from the implant insertion. -Both treatment groups scored as excellent in a range between 70% and 80% for all categories: appearance, comfort, fit, ability to chew and taste. -11% of the patients from the submerged group scored the level of satisfaction regarding appearance as fair and this score was only reported in 2% of the subjects in the transmucosal group.

Slagter, et al. 2016 (31)	-Patient VAS scores on overall satisfaction were 8,4 +/- 1,4 for the immediate group and 8,1 +/- 1,3 for the delayed group.
Den Hartog, et al. 2017 (43)	-VAS satisfaction scores were: ▪ Smooth group = 8,4 +/- 0,9 (range 6,8-10) ▪ Rough group = 9,1 +/- 0,94 (range 6,8-10) ▪ Scalloped group = 8,6 +/- 1,5 (range 4,5-10)
Gjelvold, et al. 2017 (44)	-The VAS score of the immediate loading group was of 89,6 +/- 9,5 (range 70-100). -The VAS score of the delayed loading group was of 87,9 +/- 11,3 (range 60-100).
Patil, et al. 2017 (45)	-The esthetic comparison between the crown and the neighbouring tooth with the VAS score on the control group was of 9,5 +/- 0,6 on at T0 and 9,7 +/- 0,5 after 1 year. -The esthetic comparison between the crown and the neighbouring tooth with VAS score of the experimental group was of 9,6 +/- 0,5 on at T0 and 9,5 +/- 1,2 after 1 year. -The esthetic gingiva score in comparison to the neighbouring tooth with the VAS scale was of 9,6 +/- 0,6 at T0 and 9,6 +/- 0,6 on the control group. -The esthetic gingiva score in comparison to the neighbouring tooth with the VAS scale was of 9,5 +/- 0,6 at T0 and 9,5 +/- 1,3 on the experimental group.
Jonker,et al. 2018 (46)	-The VAS score regarding the satisfaction with the crown after 1 year was of: ▪ Augmentation with membrane = 9,1 (range 8,6 – 9,9) ▪ Augmentation without membrane = 9,6 (range 8,5-9,9) -The VAS score regarding the satisfaction with soft tissue after 1 year was of: ▪ Augmentation with membrane = 8,5 (range 7,9-9,5) ▪ Augmentation without membrane = 9,2 (range 6,6-9,9) -An acceptance in the crowd result was reached in 100% in the membrane group and in 96,2% in the group without the membrane. -The soft tissue esthetics was acceptable in 96% in the group with membrane and 96,2% in the group without membrane.
Huynh-Ba, et al. 2019 (47)	-The VAS score regarding the satisfaction appearance was of 9,70 +/-0,30 on the type 1 and of 9,27 +/- 0,38 on the type 2.
De Bruyckere, et al. 2020 (28)	-The mean VAS score on the esthetic outcome of soft tissue was 84 in the control group and 87 on the test group. -The mean VAS score on the esthetic outcome of the crown was 88 in the control group and 92 in the test group.

Discussion

On this review, the 14 randomized clinical trials were published from 2007 to 2020.

Multiple treatments were evaluated on the anterior zone of the maxilla including different implants, surgical procedures, techniques, and materials used.

Once this was not the theme and the objective of this review, a further analysis of each case and its specification was not conducted. Therefore, a conclusion about a certain type of treatment and its benefits regarding the esthetic of the anterior sector of the maxilla was not attempted.

The number of participants on each study varied from 17 to 106. Therefore, a total of 756 patients were included, taking into consideration all the participants that answered the esthetic questionnaire regarding their opinion on each study.

Patients were divided into groups in every study. Two of the studies, Meijndert, 2007 and Den Hartog, 2017 (23,43) divided the patients in three groups and the others only divided the participants into two different groups in which each group had a different procedure.

All the procedures included the insertion of one implant on each patient, except for one article (45) in which two non-adjacent single implants using two different techniques were placed on the anterior zone of the maxilla.

The follow-up presented on the studies varied from 1 to 5 years. Nine of the 14 studies had a follow-up of one year (23,28,31,39,40,44–47), only two investigations had a follow-up of 5 years (41,43).

The time points when the patient-centered outcomes are collected are different from each study. Some articles only assessed the esthetic results based on the patients' opinion once (23,28,43,44,47). In contrast, a total of four time points is the biggest number of time points present on these studies and has been achieved on the article of Jonker, 2018 (46)

A preoperative esthetic evaluation has been conducted in one of the articles (46) and a subjective esthetic assessment was made in one of the studies immediately after crown placement (45). The other time points presented on the articles of this review varied from one month after crown placement to 5 years.

The follow-up of the treatments in which the objective and clinical parameters were collected were not always used as an opportunity in which the self-assessment questionnaire was conducted. This means that the follow-up appointments did not always include the respectively follow-up of the patient-centered outcomes.

The discrepancy on the time points is crucial once the time when the questionnaire is conducted may influence the esthetic patient-centered outcomes. Taking into consideration

the specifications of oral rehabilitation treatments (such as the healing times, and wear of the crowns) this difference in time points may induce in a bias when comparing these results.

The fact that some articles only evaluated the patient-centered esthetic outcome once is a factor that shows that the patient perspective of the treatment is interpreted from a static point of view which may not represent accurately the entire subject in question (28,46,48).

Objective vs. subjective of esthetics

Some elements are fundamental to reach a successful rehabilitation such as gingival design, the interdental papilla shape, the harmony of the smile-line, the aesthetic emergency angle, proportion of the teeth, proximal contact areas and gingival zenith (49,50).

Details such as little exposure of the superior teeth, a lot of exposure of lower incisors, deviation of the midline, teeth and gingival margins with asymmetry and a wide buccal corridor have a negative impact on the aesthetic result (50,51). Consequently, the rehabilitation of the anterior sector is a complex procedure (52).

In these articles, the esthetic opinion of the patient and the professional was not taken into consideration prior to the surgical procedure which conducts to a lack of data regarding the esthetic improvement noticed, including the goal of the patient and a comparison between the initial situation and the outcome. This may also be a factor that can influence the perspective of the patient and the esthetic result of the procedure.

When conducting an oral rehabilitation on the anterior maxilla, risk factors such as thin buccal bone wall and thin palatal bone, thin gingival biotype, high smile line, high patient expectation, scars and pre-existing soft tissue conditions must be taken into consideration (53,54). Therefore, treatment planning with prosthetic and surgical evaluation including the analysis of the risk factors is essential to achieve a successful esthetic rehabilitation (54).

Esthetic demands have increased which make the anterior teeth rehabilitation a challenging treatment for surgeons and prosthodontists (49,52). Regardless of this fact, nowadays, the evolution of materials and techniques make possible to achieve a pleasing esthetic outcome with lasting success (53).

Even though implant treatment has become a common treatment with high predictability on survival and success rates in the anterior and posterior area of both the maxilla and mandible, aesthetic success cannot be equally predicted (49,52).

A matter of concern in dentistry is the discrepancy between the perception of esthetic of both soft and hard tissues by dentists and patients, mostly on anterior maxillary implant

restorations (55). It is still unclear if professionals and patients have identical demands on the esthetical goals of the oral rehabilitation (37,52).

The objective parameters used by professional to evaluate the esthetic outcome of the rehabilitations are fundamental as a tool to compare the professional perspective with the patients' (46). The level of experience and the specialty of the clinician are of great matter when conducting a comparison on the level of satisfaction to the same treatment outcome (52). Less experienced dentists, such as dental students tend to be less critical (52).

In this review, thirteen of the articles used known indexes to collect information regarding objective and subjective components of esthetics. Only one of the articles (Sanz, 2015 (42)) did not include any index or scale to collect the data. The higher number of used indexes in the same article was of four (28,31).

This mean that the article of Sanz, 2015 (42) did not compare the difference between the objective and subjective parameters, and no correlation between both was studied.

Taking into consideration that each objective index analyses specific parameters, with different specifications and goals, the use of more than one index permitted to acquire more information that possibilitated a vast correlation with the subjective outcomes of the studies.

The PES/WES index was used in 8 studies (25,26,28,31,43,44,46,47). The PES index was used without the WES index in the two studies of Patil, 2017 and Esposito, 2015 (40,45). The MSI was only used in the study of De Bruyckere, 2020 (28), and the ICAI was used in five studies (23,25,31,39,41).

The patient centered scale, OHIP-14 was approached in three studies of De Bruyckere, 2020; Slagter, 2016 and Gjelvold, 2017 (28,31,44). In order to access the patients' perspectives, the VAS scale was mostly used except by three studies (40–42).

According to this review the patient satisfaction was high in all the groups of six studies (25,39–41,46,47) and no statistical difference was found between the groups of five articles (26,28,31,43,46).

A correlation was found regarding the opinion of the esthetic of peri-implant mucosa by dentists and patients on the study of Meijndert, 2007 (23) but the crown score did not correlate between the values of patient and professional results in the studies of Meijndert, 2007 and Gallucci, 2011 (23,26). The randomized controlled trials of Patil, 2017 (45) concluded that the satisfaction regarding mucogingival conditions was considered high by dentists and professionals.

The patient opinion was more positive than professional's in three of the fourteen articles (23,39,41). Accordingly to the actual literature, patients tend to have an esthetic and overall satisfaction score much higher than the recorded by professionals (14,20). In contrast, a difference on the esthetic results was found between patients and professionals without

mentioning which one was higher in two articles, Gallucci, 2011 and Jonker, 2018 (26,46). Whereas no correlation between the overall esthetic result by professionals and patients was found in the study of Meijndert, 2007 (23).

No significant correlation was found regarding the gender and age of the patients and the esthetic outcome on the article of Meijndert, 2007 (23). Patients also mentioned that they would repeat the same procedure on De Bruyckere, 2020 and Esposito, 2015 (28,40).

When comparing three indices (VAS, PES/WES and OHIP-14) a significant degree of correlation was established on the study of Gjelvold, 2017 (44).

The study of Gjelvold, 2017 (44), affirmed that a moderate correlation was found between the OHIP-14 and the VAS score and it could indicate that a low quality of life affects the perception of esthetics negatively, but no further explanation was mentioned.

All these results are limited once they represent different treatments outcomes, a disparity on the questionnaires and disagreement between the conclusions. Despite these limitations, it is possible to state that the patient satisfaction was high across the studies and a correlation between the professionals' and patients' opinions are not found in all studies or/and parameters. The gender and age of the patients may have no correlation with the esthetic result of the rehabilitation and patients stated that they felt satisfied enough to repeat the procedure.

Subjective of dental esthetics

Various terms are being used in studies to describe the results centered in the patient subjective perspective such as "patient satisfaction", "patient-centered outcomes", "patient-reported outcomes measures" and "patient-reported outcomes" (56). The increase on the expectations by patients about the dental esthetics is a factor which increases the importance of patient based interpretation (37). There has been a paradigm shift to a better understand of the "patient-centered care" in medicine (56).

The articles scrutinized on this review assumed different esthetic goals, therefore the questions asked to patients varied.

The questions presented on the studies are answered by the visual analog scales, questionnaires with 4 to 6 points and by yes or no answers.

The overall satisfaction was assessed in eight of the fourteen studies (23,25,26,31,39,41,43,46). It was presented in different forms of questionnaires. The Visual

Analog Scale was the most used regarding this topic of the questionnaire, only being substituted by a 6 grade scale on the article of Albornoz, 2014 (39) and a question in which the answer ranged from 0 to 10 on Nimwegen, 2015 (41).

It is important to notice that the term overall satisfaction may not only include the esthetic results of the oral rehabilitation, but also the outcome of the treatments as a whole (39). This may influence the results of the studies once the interpretation of the patients about the questions asked could include factors that did not necessarily correspond only to esthetic parameters.

The esthetic result regarding the mucosa and the crowns has been assessed separately by five studies (Meijndert, 2007; Den Hartog, 2011; De Bruyckere, 2020; Nimwegen, 2015 and Jonker, 2018 (23,25,28,41,46)). Terms such as “esthetic appearance” (39), “esthetic satisfaction” (39,44), “aesthetic outcome” (40), “esthetic point of view” (45), “appearance” (42), “satisfaction appearance” (47) have also been used across the studies. This indicates that the questions were not the only factors that differed, but also the nomenclature and how the concepts were labeled. This adds more differences between the questionnaires which conducts to a bigger disparity between the results of the studies.

The number of questions presents in the questionnaires addressed to the patients were not always mentioned in the studies. And when the information regarding the number of questions was present, the question itself was only occasionally mentioned. No supporting information of any study presented this information.

Only four of the studies presented the number of the questions regarding esthetics and the questions itself (De Bruyckere, 2020; Patil, 2017; Esposito, 2015 and Gjelvold, 2017 (28,40,44,45)). Taking in considerations the four studies which presented this information, they varied from 1 to 3 questions per study.

Three of the fourteen studies did not use the VAS scale in order to collect data regarding the opinion of the patients (40–42). All the studies which used the VAS scale assumed that the results from the scale could assume values from 0 to 10 or from 0 to 100 and the length of the line was mentioned as having 10 cm or 100 mm. This difference is not relevant once it is just a variation of the same data with a probable difference in sensibility.

The studies, which used VAS, described different words and expressions on the extremities of the scale used. All the articles cited as the lowest score on the left of the scale and the most positive score as the right extremities of the scale.

The words mentioned included mainly the word satisfaction and its derivates. The word satisfaction was used in a positive way with expressions such as “very” (25,43,44), “most” (28), “completely” (47) and “fully” (26). When used in the negative form, derivates such as “very

dissatisfied" (25,43), "not satisfied at all" (26,44), "not satisfied" (47), "most unsatisfied" (28) were applied. Numbers such as 0 and 10 were used by three articles (23,31,46), and expressions that compared the outcome of the treatment with the similarity of the natural dentition have also been used (45).

Therefore, the term "satisfaction" is the central word when correlating the esthetic perspective of the patient. A need for standardization of the VAS scale used, including the expressions and units to measure of the length of the scale is noted to improve the quality of the results and its reproducibility.

Even though the theme of esthetic is being discussed, variations regarding the details are found. As we can see by the topics and the questions present in each study, all of them present diversity between each other.

Many studies did not describe the details regarding the way the questions were presented to the patients. Only 5 articles gave information about who was present in the room during the questionnaire, if the questions were written or spoken and the pronunciation of the person who read the questions (28,39,40,42,45). The use of a mirror to access the self-image at the moment of the questionnaire was used in two studies (40,45). Only 1 study stated that the participants also saw a picture of themselves at the moment of the answers (45). This could lead to a bias in which the methodology used in the questionnaire could have an impact or influence the answer provided by the patients.

No study presented an open question that could enable the patient to expand their answer and provide more information about the theme. Only the answers of the questionnaires are taken into consideration, which led to restrict surveys that did not manage to further understand the patient's expectations. This show that the patient has no space to communicate further relevant information.

An important fact is that the inclusion of open questions could increase the disparity of questionnaires and difficult a comparison between results. Therefore, it is a complex matter in which the open questions are relevant to understand the patient perspective more accurately but tend to be too subjective. These types of questions should be included in studies which have the goal to define the most important esthetic factors taken into account the patients' opinion but avoided in studies which pretend to compare the results of different procedures. Therefore, a complex understanding of the patient perspective would not be neglected and the rationalization of esthetic itself could be achieved.

When interpreting the results from **table 4** it is important to keep in mind that this information is the product of different questions of the questionnaire. Even though the overall patient satisfaction was high, the numbers have different meanings, and a direct comparison can not be realized once no study presented the same question followed by the same

expression on the extremities of the VAS scale. Once articles such as the Jonker, 2018 (46) differentiated the results based on the crown, soft tissue and on the acceptance of the results, other articles such as the Albornoz, 2014 (39) only mentioned the total VAS score.

It is important to notice that the results presented are satisfactory in general.

As mentioned before, different questions are made in these questionnaires in which the way the questions are presented to the patients vary widely also. The articles present several important differences and variables that should be taken into consideration when conducting questionnaires about the esthetic opinion of a patient and an oral rehabilitation treatment. Factors such as the way the questions are made, when the questionnaire is conducted, the number of questions, the formulation of the questions and the words used, and the possible answers are relevant factors that contribute to the objectivity and rationalization of a complex theme as esthetic.

There are still many questions that may be raised to better comprehend the esthetic goals desired by the patients. This situation can conduct to a serious deficit in information which impact the overall data regarding this theme and how the treatment of anterior sector of the maxilla could be improved.

An uniformizations of the information collected is required to promote awareness and enhanced understanding regarding this theme. According to this review the questionnaires should be conducted in a written format, without any intervenient. The explanation of the patient-centered outcome should occur prior to the surgery and repeated moments before the questionnaire.

The follow-up of the studies should comprehend more than one year, and all the follow-up visits should be used as a time point in which the questionnaires are conducted. The time points that are seemed to be more indicated are after 1 month of crown placement, 6 months, 1 year, and every year after that. A preoperative time point should also be included in all the studies once the consults of preparation for surgery can easily include a questionnaire and the collection of this results could be of great relevance for the subject.

The questionnaires should include, firstly, the overall esthetic satisfaction of the patient, followed by the opinion about the crown and mucosa. The questionnaires should have at least three questions.

The questions recommended are:

1. “Are you satisfied with the overall esthetic result of your treatment?”
2. “Are you satisfied with the esthetic outcome of your implant teeth?”
3. ”Are you satisfied with the esthetic outcome of the gums surrounding this implant?”

The VAS scale is the most appropriate and valid measurement method regarding this theme so it should be elected as the standard one. The scale should be included in the studies in millimeters and the results presented with two decimal places. The expressions on the extremities of the VAS scale should always use the words “Very dissatisfied” on the left and “Very satisfied” on the right.

Modifying factors

Patient satisfaction is an extremely complex matter which is difficult to evaluate and dentists should better understand and deal with it with familiarity, knowledge and support (37). In the same way, there are many factors which influence the perception of beauty (56).

The individual perception of the esthetic outcome of the treatment can be influenced by factors such as the social environment, education and cultural background (28,56). All the studies included in this review did not mention a correlation between factors such as social environment and its implication regarding esthetics.

The face of a person represents a unique social stimulus that host a collection of information such as race, gender and emotions (57). Age and gender are factors that influence the objective and perception of esthetic on dental procedures (55,58). The expectation on esthetics differs depending on the age of the subject (58). Younger patients are known to expect a smile with more maxillary gingival display, no black triangles between the central incisors and more exposition of the superior teeth (59). Younger patients’ expectations regarding the color of the teeth presents a lower satisfaction score, which appoints to the fact that it is linked to cognitive factors (58). Females reveal less satisfaction with their smiles than males, and psychological elements are the essential predictor of their esthetical opinion (55,58).

Even taking this information into account, only the study of Meijndert, 2007 analyzed the correlation between the age and genre and the results from the patient centered outcomes regarding esthetics (23). No significant correlation was found in this article about these two variants and the esthetic results of the patients (23).

A preoperative evaluation of the esthetic satisfaction of the patient was only assessed on the study of Jonker, 2018 (46). According to the actual reports, the preoperative situation and expectations are of great importance in the final opinion of the treatment outcome (52). In circumstances when patient’s expectations are low since the pre-operative conditions were

compromised, a poor outcome for the dentists may be perceived as a successful treatment by the patient (52).

Factors such as genre, age, social environment, level of education, cultural background and the patient's expectations should be more comprehended and applied to the dental practice, so it makes possible to improve the treatments and meet the specifications of each patient.

Conclusion

Once esthetics and the opinion of each individual is by itself a complex and difficult subject to be addressed. Dentists should better understand the external factors that have relevance to the patient perspective and point of view in order to comprehend the circumstances of each case and be able to provide a qualified approach and a quality treatment.

Overall esthetic satisfaction and the patient opinion regarding the crown and mucosa are the parameters that are taken more into consideration on the randomized controlled trials analyzed. The patient-centered results about the esthetic opinion of the patients tend to be more positive than the professionals' evaluations.

The questionnaires should be standardized in future investigations so more accurate results could be achieved.

A lot of questions remain unanswered regarding this theme. More investigation is needed to provide solid and trustful results.

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