



INTERDISCIPLINARY TREATMENT PLANNING FOR SINGLE-TOOTH RESTORATIONS IN THE ESTHETIC ZONE; A REVIEW

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Abstract

Background: The use of implants as a form of treatment is frequently an alternative to more traditional techniques. The most obvious factor motivating people to look into replacing their missing anterior teeth is diminished appearance. Dental plants are being used more and more to replace single lost maxillary teeth in the smile's aesthetic zone. Dentistry must adopt an interdisciplinary approach because the information and abilities required to treat patients successfully are becoming more complicated. This method is required to guarantee accurate diagnosis, achieve a higher standard of work, and increase the range of available treatments.

Aim: To overview the interdisciplinary planning for the treatment of single-tooth restoration in the esthetic area.

Methods: The articles involved in this review were obtained by searching PubMed, Google Scholar, Science Direct, and Research Gate. A variety of terms related to our subject were used for the search process "Restoration, Implant, Treatment, Planning, Interdisciplinary, Single-tooth, Esthetic zone, Esthetic region." Articles were selected based on the pre-defined inclusion criteria.

Results: Original studies, and review articles written in the English language were eligible for this review. The discussion of the review included six main titles to cover the current subject as possible.

Conclusion: Restoration of a tooth in esthetic appearance via implanting requires a successful implanting process which in turn requires interdisciplinary planning for the treatment process. Treatment planning for single-tooth restoration at the esthetic zone requires five main steps; patients' selection, bone anatomy, pre-implanting imaging, implant selection, and implant placement and position.

Keywords: Treatment, Planning, Single tooth, Restoration, Esthetic region.

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1. INTRODUCTION

Implanting has become a necessary part of dentistry in the last decade as it helps to improve the life quality of a huge number of patients. Implant therapy can often be replacement to classic methods; however, in certain cases, it may be the first choice for the rehabilitation of severe anatomical, functional, or esthetic issues due to tooth loss [1].

Two decades ago, implant strategy was confined for specialist dental teams working at specialized centers or universities who treated severely atrophic

edentulous patients. However, the indications for implant management in the 90s gradually varied from fully edentulous to partially edentulous patients [1].

The most obvious reason for wanting to replace missing anterior teeth is a decline in appearance. Dental plants are being used more frequently to replace single missing maxillary teeth in the smile's aesthetic zone, particularly in patients whose neighboring teeth are largely free of decay or other problems [2]. Although tooth loss has become less common over the past few decades, up to 25% of

individuals in Western nations are still missing one or more anterior teeth [2].

The reason for a single tooth loss in the esthetic area stems involves acquired tooth loss or developmental hypodontia [2]. Acquired missing of anterior teeth at a younger age is mostly due to frequent trauma, but over the lifespan of an adult, the reasons can include dental caries, periodontal disorder, and less common reasons such as neoplasia and persisting oral habits [2]. Hypodontia refers to tooth agenesis, and it is the most widespread developmental abnormality in humans [3], involving those caused by genetic and environmental factors [2].

An interdisciplinary approach must be incorporated into dentistry as there is an increase in the complexity of the knowledge and skills needed to effectively provide care to patients [4]. This approach is necessary to assure right diagnosis, attain a higher quality of work, and expand treatment options [5]. Therefore, a team involving various specialties in which each individual contributes their skills and knowledge to manage problems, diagnose the condition of cases as well as plan and execute therapies [6].

An interdisciplinary approach is important in dentistry for complete, inclusive, and effective care of patients as patients become more discriminating, increasing demands for more precise diagnosis and more detailed treatment plans [7]. So, this review was conducted to overview planning for single tooth restoration in an esthetic zone based on an interdisciplinary approach.

2. MATERIALS AND METHODS

The articles involved in this review were obtained through searching through PubMed, Google Scholar, Science Direct, and Research Gate. Several keywords related to our subject were used for the search process "Restoration, Implant, Treatment, Planning, Interdisciplinary, Single-tooth, Esthetic zone, Esthetic region." These words were used in various combinations to obtain all possible articles. The articles that resulted from the searching process were reviewed firstly for titles, and irrelevant articles that appeared coincidentally were excluded. The second step involved reviewing the abstracts of articles discussing our subject of interest. Duplicate articles, articles available for abstract only, and letters to editors were excluded. Articles written in the English language were eligible. Also, original studies and review articles were eligible and included in our review. The discussion of the review included six main titles to cover the current subject as possible.

3. DISCUSSION

-Dental implant:

A dental implant is a portion of material that surgically interfaces with the jaw bone or the skull to reinforce a dental prosthesis such as a bridge, crown,

facial prosthesis, or denture or acts as an orthodontic anchor. A biological process called osseointegration is the basis of modern dental implants; the process involves substances such as titanium forming an intimate attachment to bone [1].

The implanting process involves placing the implant so it is likely to osseointegrate, and then the dental prosthetic is added. The time required for osseointegration before the dental prosthetic is bound to the implant is variable [8].

The implant supplies a foundation or anchor for the restoration; it is screwed into the bone where the tooth is missed providing a fixed platform on which an abutment can be screwed. The bony tissue grows around the implant, strengthening and regenerating the jaw and reducing the bone loss which comes due to natural tooth loss [1].

The abutment which is made from titanium supplies support for the crown; it is also the interface between the implant and the crown [1]. The crown is the upper part of the restoration and is the part observed in the mouth. It replicates the genuine tooth to maintain a biting surface and esthetic look. It is hand-made by the technician from porcelain or metal. The completed crown is screwed onto an abutment or cemented [9].

-Patient selection:

The patients should be comprehensively evaluated, including dental examination and medical history. The dental examination should consider active infections such as endodontic lesions, caries, and periodontitis and treat such problems before implantation. The latter must be performed for systemic conditions to avoid complications during treatment. For example, chronic therapy or non-controlled diabetes mellitus can affect the healing ability of the patients [10]. Also, smoking is an absolute contraindication for implant placement, and patients should stop smoking before implant treatment because smoking is associated with higher rates of implant failure [11].

Also, this initial and comprehensive assessment of patients reveals if the case is a candidate for implant or not. This process also will help in the selection of an appropriate implant system that meets the functional and esthetic needs of the patients [12].

Candidate patients for an anterior tooth surrogate with an implant should be aware of the benefits of implant restoration as well as the additional duration required for treatments. Clinicians should know and understand the desires of patients. In most cases, patients aim to obtain an esthetic tooth replacement. Therefore, clinicians should consider and act to obtain successful esthetics with long duration of stability [13]. Hence, the esthetic expectations of patients must be estimated with their lip length and activity. Almost 75-100% of interproximal gingival and maxillary incisors are shown in an average smile, whereas a high smile, involves observation of additional gingival tissue [13].

A high lip line makes the entire maxillary anterior tooth and a sizable amount of supporting tissue visible, which poses a considerable cosmetic concern. Soft tissue failure and emergence profile esthetic failure are risks connected to this. This gingiva biotype carries a risk of soft tissue discoloration and recession, and it frequently necessitates periodontal surgery [14]. Therefore, a high smile line represents a potential challenge during planning for an implant in the esthetic area as the gingival tissues and restorations are totally observed. Hence, maximal efforts should be exerted in such situations toward maintaining peri-implant tissue support throughout treatment phases, including planning, provisional, surgical, and restoration [13]. On the other hand, a low smile line results in fewer issues as the interface of the implant restoration will be invisible behind the lip [13].

-Periodontal health and Bone anatomy of the implant site:

A periodontal evaluation is an essential part of the implant planning procedure, as the health and anatomy of the periodontium are important for successful implant treatment. It is crucial to maintain and establish the health of the mouth and treats periodontal disease because the infection can negatively affect implant therapy [11]. Also, it is important to analyze the anatomy of the periodontium during implant planning. The quality of hard and soft tissue of the mouth determines the esthetic outcomes of the implant [11], as endodontic infection, periodontal disease, and bone remodeling procedure after extraction of the tooth may result in reduction in the bone volume required for implantation [10].

Bone density is a key factor in treatment planning, design of the implant, surgical approach, and healing time [15]. The determination of the available bone is necessary for successful implantation. The definitive implant restoration needs to be encircled by a soft and hard tissue that is in harmony with the surrounding dentition [13].

The available bone of a single tooth is that part of a partially alveolar ridge used to insert the implant [16]. The bone housing must have a three-dimensional configuration that allows for the implantation of an implant in a restoratively optimum position for successful aesthetic restoration [13].

Length, width, and depth are the three dimensions of the available bone. The depth is the measurement from the top of the bridge to the closest limiting feature. The length is the mesiodistal dimension, the width is the buccolingual dimension [16].

Adequate mesiodistal space must be present depending on the tooth being replaced to provide a restoration that stimulates natural tooth contours [17]. The mesiodistal space should be similar to that of the contralateral tooth [13].

If insufficient prosthetic space is present, it must be generated via enameloplasty on the neighboring teeth or by moving the teeth using orthodontics [17]. It is

important to assess the anatomy of the facio-lingual ridge to see if there is enough crest width for the implant [13].

The bone width should be such that more than 1mm of bone and present on either side of the implant faciolingually to maintain the stability of the soft tissue [15]. The ideal positioning of implant for deficient alveolar crest width requires bone augmentation [13].

Since intraoral radiographs are two-dimensional and are determined clinically, it is impossible to measure the breadth of the accessible bone on them [15]. Deficits in this dimension can be identified using clinically sound methods or complex radiographic procedures like CT scans or tomographs [13]. Planning might be aided by a diagnostic wax-up indicating tissue deficit and final tooth location [13]. To determine the mesiodistal position of the roots close to the implant site, preapical radiographs are employed [10].

The apicocoronal dimension, which can be deficient due to infection, trauma, or periodontal disease, remains the most important dimension. Utilizing a diagnostic template that shows the intended gingival margin of the implant restoration is the most effective way to evaluate this dimension.

The bone required for housing an implant of 3.75mm diameter is 6mm and 5-6mm of bone in buccolingual and in mesiodistal dimensions, respectively [10]. Additionally, the absence of the bony vertical height at the implant site is the most challenging condition, and it is an obstacle to achieving esthetic outcomes [10, 18].

An important indicator of gingival levels is the location of the osseous crest. The risk of tissue loss following an invasive operation increases with the distance from the osseous crest to the free gingival edge. Less than 3mm or more than 3mm indicates that the change will be more than 1mm [13]. Because there is insufficient interproximal papilla when there is crestal bone loss at the neighboring tooth, aesthetic effects are compromised when the distance to the contact site is 5.5mm or more [18].

-Pre-implant imaging:

Imaging before implantation can be considered a component of patient assessment and can be considered a strategy for the evaluation of bony anatomy. Also, a comprehensive radiographic evaluation is necessary for the assessment of the implant site [11].

Imaging before implantation includes all radiological assessments that help in the determination of the treatment plan of the patient. A variety of imaging tools are obtainable for the presurgical implant assessment. During this phase, intra-oral periapical radiographs with panoramic images are the minimally required modalities [15]. Panoramic films provide only two-dimensional images releasing a little of the complex three-dimensional bony anatomy [11].

Computerized digital radiovisio-graphy is becoming a routine in implant practice. It can indicate relative bone densities with reduced doses. Interactive computed tomography modality is more acute and able to determine the bone quality through a density value [15]. The use of three-dimensional cone beam computed tomography (CBCT) is highly recommended by many practitioners as it produces a highly detailed, distortion-free image of the underlying anatomy, which is very useful for precisely locating vital structures, measuring linear dimensions, evaluating alveolar ridge topography, and fabricating surgical stents [11].

-Implant selection:

The material and abutment design for a single anterior implant must fulfill a number of requirements, including the precise fit of the mating components to avoid screw loosening during function, biocompatibility, long-term stability, and esthetics [19].

The site anatomy and upcoming implant-supported repair dictate the size and shape of the implant [20, 21]. Predictable therapeutic outcomes are offered by screw-type implants with nano- and micro-rough titanium surfaces. Improved surfaces that have been chemically altered and have hydrophilic properties hasten osseointegration and enable earlier implant loading [22]. Yttrium-partially stabilized tetragonal zirconia (Y-TZP) due to favorable esthetics, high resistance to fractures, flexural strength, and excellent osseointegration might be an alternative [23, 24].

For the lateral incisor region, a narrow neck implant should be used, whereas regular neck implant can be used for the region of canine and central incisor where the tooth width is at least 7mm. Educated diameter implants with new titanium-zirconium alloy that displays high mechanical strength can be a viable alternative to the extensive bone augmentation process. Wide-platform and wide-neck implants should be excluded in the esthetic zone since implant shoulder placed to facially causes resorption of the facial wall and gingival recession [25, 26].

- Placement of the implant:

After extraction of tooth, the implant can be positioned in four periods; immediately after extraction, early following soft tissue healing, early after partial bone healing, and after complete socket healing. However, the advantages and disadvantages of each type should be declared to the patient [27]. The immediate implant is a particular challenge in the esthetic zone [27] as this approach is associated with an elevated risk of gingival recession, although it provides a reduced time of treatment [18]. Only a limited number of cases are candidates for this approach, and they include cases with low esthetic risk, with no infection at the extraction site, with intact bone walls, and a thick facial bone wall of at least 1mm [27]. The immediate implant protocol is very important in the esthetic region in some

conditions, such as inadequate of soft or bony tissues in patients with a high smile line which results in esthetic failure [18].

The second duration after soft tissue healing occurs within the first 4–8 weeks following tooth extraction is the recommended procedure for the esthetic zone [25, 27, 28]. At that point, the soft tissue has fully recovered, and a bundle of bone resorption has resulted in a small flattening of the buccal wall. The main goal of this procedure is to repair soft tissue in order to provide a large enough volume and keratinized mucosa zone to allow for the primary tension-free closure after a guided bone regeneration process. The risk of problems during anesthesia is decreased by this strategy. Additionally, this approach is appropriate for the majority of patients with low to moderate esthetic risk. However, some cases require deviation from this approach; such cases have large defects of the apical bone that compromise primary stability of the implant. Therefore, type three, where the implant placement following 12-16 weeks, is indicated [27].

The newly formed bone in the extracted socket supports the implant and provides sufficient primary stability; however, flattening of the facial bone wall occurs at the same time as a result of bone remodeling and requires contour augmentation using bone filler with slow resorption rate for acceptable esthetic outcome [25, 27].

Correct three-dimensional implant placement is necessary for long-term peri-implant soft and bone tissue maintenance that would provide functional and esthetic restoration [18]. The placement of single implant restoration is a well-documented and predictable operation [29]. The majority of times when a single anterior implant restoration is involved, aesthetic factors take precedence over functional ones [13].

An essential component of aesthetic restoration is implant depth. The implant shoulder is typically 2 mm below the midfacial gingival edge in cosmetic areas. The interproximal margin at these locations can be as deep as 5-7 mm due of the more prominent gingival scallop that typically occurs there [29]. To prevent the resorption of the interproximal alveolar crest, the implant shoulder needs to be at least 1.5mm distant from the adjoining tooth's root in the mesiodistal dimension. Approximately 1 mm apically from the Demento-enamel junction of the adjacent teeth should be where the implant shoulder is inserted. The shoulder of the implant should be positioned 1.5 to 2 millimeters palatally from the imaginary line connecting the emerging points of neighbouring teeth in the orofacial dimension [25]. It is challenging to sit down for the repair and cement removal because of this shoulder location [29].

A misaligned implant causes gingival recession, prosthodontic difficulties associated to restorations, bone resorption, and a thin and insufficient facial wall of the implant bed site [18]. By using lab

simulations, computed tomography with CAD/CAM simulations, and surgical stents, the site of the implant is decided by the angle and position of the neighboring teeth [1].

4. CONCLUSION

A dental implant is a treatment strategy for the restoration of lost teeth. The loss of anterior teeth affects the esthetic appearance of the individual. Restoration of esthetic appearance via implanting requires a successful implanting process. Successful implanting, in turn, requires interdisciplinary planning for the treatment process. Dentistry must adopt an interdisciplinary approach because the information and abilities required to treat patients successfully are becoming more complicated. This method is required to guarantee accurate diagnosis, achieve a higher standard of work, and increase the range of available treatments. With patients becoming pickier and demanding more precise diagnoses and intricate treatment plans, an interdisciplinary approach is crucial in dentistry for complete, comprehensive, and effective patient care. Interdisciplinary treatment planning for single-tooth restoration requires five main steps involving patient selection, periodontal health, and bone anatomy, pre-implanting imaging, implant selection, and implant placement and position. Additionally, each step involves further considerations that should be planned, assessed, and performed carefully for the best outcomes.

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