



Major advances in minimally traumatic surgery in implantodontics: the concise systematic review

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Abstract

Introduction: Dental implant procedures have reached about one million dental implants per year in the world. In this context, it is necessary to establish the state of the art of minimally traumatic procedures for dental implants, especially after bone graft procedures and/or the use of biomaterials for bone elevation. In this context of optimizing techniques for better management of dental implants, faster and more accurate methods were developed by dentists, with post-operative results with better results and quality of life, through minimally invasive procedures. **Objective:** To carry out a concise systematic review of minimally traumatic surgery for dental implants, as well as to elucidate the main techniques for this. **Methods:** The rules of the Systematic Review Platform-PRISMA were followed. The survey was conducted from July 2021 to October 2021 and was developed based on Scopus, PubMed, Science Direct, Scielo, and Google Scholar. Study quality was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument. **Results:** Since the most primordial extraction techniques were created and developed, several attempts have been made to minimize the professional's effort, reduce surgical time and alleviate bleeding and inflammatory processes, edema, pain, and ecchymosis that can affect patients, in the trans and postoperative periods. Thus, the maximum preservation of the integrity of the soft tissues (papillae and free and inserted gingival band) adjacent to the prosthetic spaces should be sought; preservation of the alveolar bone ridge level. Based on the histological concept in which living tissues are formed by cells joined by thin

elastic tissue and with nerve fibrils, capillaries, lymphatic and blood vessels. The disruption of these cells by surgical trauma provides the release of enzymes that delay healing. For this reason, surgical trauma should be minimized. **Conclusion:** There are many attempts to minimize the professional effort, reduce surgical time and alleviate bleeding and inflammatory processes, edema, pain, and ecchymosis that can affect patients. Thus, the maximum preservation of the integrity of the soft tissues adjacent to the prosthetic spaces and the preservation of the level of the ridge of the alveolar bone to achieve a minimization of surgical trauma must be sought.

Keywords: Minimally traumatic surgery. Implantology. Clinical studies.

Introduction

Dental implant procedures have reached about one million dental implants per year worldwide [1]. In this scenario, maxillary atrophy is a frequent clinical condition and the cause that lead to focal or generalized atrophy [1-3]. Bone density influences the operative protocol and the choice of implant type used to replace lost teeth [4]. In this context, it is necessary to establish the state of the art of minimally traumatic procedures for dental implants, especially after bone graft procedures and/or the use of biomaterials for bone elevation.

In this context, the transfer of a natural tooth from its socket to another site is related to extensive caries, root resorption, periodontal disease, coronary radicular fracture, agenesis, and aplasia of teeth. The technique

must be atraumatic for a better prognosis of the tooth to be transplanted since the periodontal ligament must not be manipulated, as it is necessary to repair periodontal tissues [5].

Furthermore, with the increasing modernization of implant dentistry, we have immediate implants as the procedure with the highest probability of success among the rehabilitation treatments of the oral cavity, using osseointegrated implants [5]. Immediate implants are those installed soon after the extraction of compromised roots or teeth, using, for that, the remaining alveolus for implant placement, minimizing trauma, and optimizing treatment [5,6].

Among the several advantages that immediate implants provide, there is good acceptance by the patient, a reduction in the number of surgical interventions, in addition to limiting the resorption of the residual alveolar bone ridge [5]. Added to this, there is the possibility of installing a temporary tooth in acrylic resin or light-curing, fixed on the newly installed implant, further reducing bone loss and preserving the gingival contour of the region, restoring esthetics, smile and reintegration Social. Thus, this procedure is called "immediate esthetics" over the immediate implant. However, for results with a good critical level of significance, the implant must have a large part of its spiral surface anchored in healthy and natural bone [5-7].

Also, a significant and useful procedure, directly associated with immediate implants, is the technique known as root burial, which allows for a proliferation of the inserted gingiva sufficient for sometimes total covering of the alveolus after the installation of the immediate implant, without the need for total flap relaxation, if it does not receive a temporary tooth in the same implant installation session. However, it is not a technique widely used by some specialists, despite being easily performed and being able to provide great biological and aesthetic benefits [8].

In this context of optimizing techniques for better management of dental implants, faster and more accurate methods were developed by dentists, with post-operatives with better results and quality of life, through minimally invasive procedures with the development of numerous software and hardware (equipment and instruments) for performing computer-guided (CG) surgeries [9]. In this sense, it is essential to perform Computed Tomography (CT) on the patient, with reference points, such as the prosthesis itself, to capture images on a computer, with the images processed in the programs as an example [10].

This software allows the placement of implants in the program, as well as the creation of a high-precision

surgical guide, leading to the possibility of performing flapless surgeries, for placing the implants and prosthesis under immediate load on patients [11]. The accuracy of Guided Surgery systems for the placement of dental implants depends on a number of interacting factors [12]. In this sense, information gaps include the image acquisition process, the registration process, software navigation, the production of the surgical guide, and human error [13-15].

Although the placement of the implant with the aid of the computer requires greater investment and effort, it seems to provide a good result, in the sense of eliminating errors and systematizing the successful reproduction of treatments [16]. Added to this, CG allows the protection of critical anatomical structures, as well as aesthetic and functional advantages that come from placing the implant in the location determined by the prosthesis. CG is not indicated in easy cases, with sufficient anatomical guidance and bone volume [17], but it helps in cases where CT is recommended as a diagnostic tool, when precise placement of the implant is necessary, and when implants with longer lengths are desired for the optimal use of available bone [18]. Still, this made it necessary to include the use of planning guided surgical (PGS) and computer-aided design and manufacturing (CAD-CAM) and three-dimensional printing [19].

Therefore, the present study aimed to carry out a concise systematic review of minimally traumatic surgery for dental implants, as well as to elucidate the main techniques for this.

Methods

Study Design

The rules of the Systematic Review Platform-PRISMA (Transparent report of systematic reviews and meta-analysis-HTTP: [//www.prisma-statement.org/](http://www.prisma-statement.org/)) were followed.

Data Sources and Research Strategy

The search strategies for this systematic review were based on the keywords (MeSH Terms): "Minimally traumatic surgery. Implantology. Clinical studies". The survey was conducted from July 2021 to October 2021 and was developed based on Scopus, PubMed, Science Direct, Scielo, and Google Scholar. Furthermore, a combination of the keywords with the Booleans "OR", "AND", and the operator "NOT" were used to target the scientific articles of interest.

Study Quality and Risk of Bias

Study quality was based on the GRADE instrument

and the risk of bias was analyzed according to the Cochrane instrument.

A total of 125 articles were found in relation to the descriptors Minimally traumatic surgery, Implantology, and Clinical studies. Initially, duplication of articles was excluded. After this process, the abstracts were evaluated and a new exclusion was performed, removing the articles that did not address the topic of this article. In total, 74 articles were fully evaluated and 30 were included and evaluated in the present study (**Figure 1**).

After the complete analysis of 30 studies, it was found that the care directed at the implant dentistry process is very important, given that the lack of bone in the alveolar crests has been a major problem in functional aesthetic recovery in patients with dentoalveolar trauma [20], tooth extractions, periodontal disease, congenital tooth absence, maxillary and mandibular pathologies, in addition to infections due to the emotional and the possibility of deformities due to the lack of protein load [1-3].

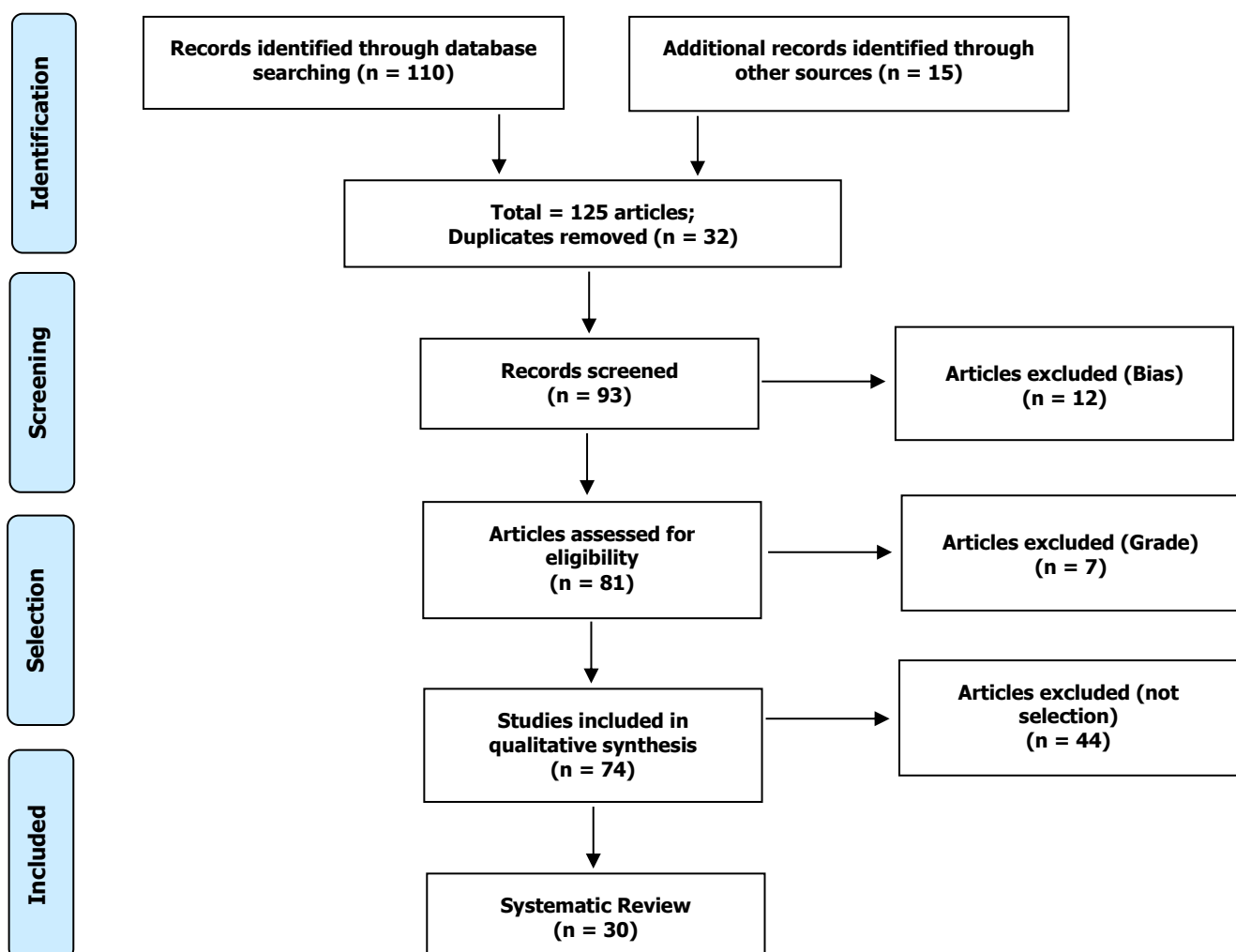
As literary support, a study evaluated the stability of immediate implant placement for alveolar bone

augmentation and preservation with bovine bone graft after atraumatic tooth extraction. Therefore, the insertion of immediate implants in extraction cavities with bovine bone with an increase in the buccal gap was able to preserve a greater amount of alveolar ridge volume. There are no clinical studies evaluating the feasibility of a new technique for the surgical extrusion of non-restorable teeth with subgingival caries [5].

Another study analyzed that the combination of piezo-surgical surgery and conical expanders allows a safe displacement of the selected bone flap, as well as the immediate placement of the implant, avoiding the risk of slipping, overheating, or fracture, allowing operational comfort. Thus, non-traumatic bone expansion is a reliable, reproducible, conservative, and cost-effective procedure [7].

Thus, the application of minimal intervention concepts in dentistry and minimally invasive surgical techniques can offer a powerful arsenal to the general dentist to provide ethical and conservative treatment to elderly patients. When it is unavoidable, surgical intervention should be as minimally invasive as possible

Figure 1. Study eligibility.



in elderly patients to preserve the longevity of their natural dentition [21].

In this sense, performing indiscriminate extractions, without the objective of immediate or late rehabilitation of the new prosthetic space, promote serious biological and social consequences generated by tooth loss without adequate rehabilitation [6]. Thus, due to the enormous advance in minimally invasive techniques and the spread of modern implantology, and the level of safety of the treatment provided by it, in addition to the refined techniques for making conventional prostheses relatively safe if planned correctly, the patient can have adequate rehabilitation with various techniques [22,23].

If the maintenance of the original tissue contours is respected, the chances of achieving good esthetic levels and acceptable functional conditions increase considerably. These precautions are even more important and critical when the surgical procedure is performed in anterior regions of the mouth [6].

The preservation of interproximal bone levels is essential to maintain the vertical level of the interdental papillae, avoiding dark areas and spaces between natural and artificial teeth, which can impair the aesthetic result that can produce real satisfaction for the patient [24]. Likewise, the preservation of bone and gingival integrity can drastically reduce the volumes of medication administered in the postoperative period and facilitate the making of appropriate profiles and contours of temporary gingival conditioning, even with conventional prosthesis procedures and techniques or immediate implants with immediate esthetics, are used for the rehabilitation of the case [5,6].

Since the most primordial extraction techniques were created and developed, several attempts have been made to minimize the professional's effort, reduce surgical time and alleviate bleeding and inflammatory processes, edema, pain, and ecchymosis that can affect patients, in the trans and postoperative periods. Thus, the maximum preservation of the integrity of the soft tissues (papillae and free and inserted gingival band) adjacent to the prosthetic spaces should be sought; preservation of the alveolar bone ridge level [6].

Furthermore, the atraumatic restorative treatment (ART) was developed by Frencken in Africa in order to control the evolution of caries. The main functions of the ART are a preservation of the tooth structure with minimal operative intervention, reduction of endodontic treatment or tooth extraction, and reduction of patient discomfort due to no need for local anesthesia.

Furthermore, the authors compared the psychological behavior of children when using ART in relation to conventional treatment. Heartbeats were

monitored throughout the procedures and researchers concluded that manual instruments in atraumatic treatments caused less discomfort and anxiety than rotary instruments in the conventional technique [25].

Furthermore, glass ionomer cement (GIC) are widely used in dentistry for their cariostatic effect, due to the release of fluorine in the most superficial layers of restorations [26]. Also, in addition to releasing fluoride, the ivs are able to incorporate it again from toothpaste. However, the limitations regarding the use of the VSD are related to its physical properties and aesthetic limitations.

Based on the histological concept in which living tissues are formed by cells joined by thin elastic tissue and with nerve fibrils, capillaries, lymphatic and blood vessels. The disruption of these cells by surgical trauma provides the release of enzymes that delay healing. For this reason, surgical trauma should be minimized. Trauma prevention is done through good surgical planning, working together, good lighting, control of force, knowledge of topographical anatomy, control of movements and gestures, search for a support point to reduce tremor, and decreased surgery time [27].

The basic rules that guide the doctrine of atraumatic surgical technique are the surgeon without tension, minimal and precise movements, dissecting only what is essential, reducing tissue exposure to a minimum, gentle handling, use of correct instruments and techniques, use of soaked swabs in warm saline solution [28]. As proof, the atraumatic extraction techniques have several advantages over the conventional techniques performed today, mainly with regard to maintaining the integrity of the alveolar bone and attached gingiva. They consist of controlled techniques, with a high level of predictability [29].

However, the technique of controlled avulsion extraction can be considered the most predictable, ensuring maximum integrity of the alveolar bone wall, drastically reducing bleeding and especially the time of the procedure. Among the contraindications observed in this type of technique performed with the Xt Lifting®, we can mention the extraction of residual roots that are structurally very fragile, with very thin dentin walls, due to internal resorption or wear for the installation of metallic cores, among others. However, some of the innovations that are being developed exclusively for the Xt Lifting® system have emerged with great success, with the aim of guaranteeing the execution of atraumatic extractions in a wider range of clinical situations [29].

Added to this, with regard to cardiology, there is the ART which provides a glimpse of several minimally traumatic treatment options, depending on factors such

as esthetics, tooth function, patient expectations, cost of restoration, and optimization of surgical techniques. Thus, several authors have listed the advantages of ART, such as greater preservation of the tooth structure, curative and preventive technique in a single procedure, preservation of the innermost dentin, reduced trauma, less risk of pain, no need to use anesthesia, reduced the anxiety of patients, greater acceptance by adults and children, lower cost, speed of execution, the possibility of correcting the inadequate technique, good clinical performance in restorations on one face, the possibility of execution in social spaces such as schools, daycare centers or at home [25,30].

Conclusion

Studies have shown that there are several techniques to minimize the trauma of dental implant surgeries, such as bleeding, inflammatory processes, edema, pain, and ecchymosis, seeking maximum preservation of the integrity of the soft tissues adjacent to the prosthetic spaces and the preservation of the level of the edge of the alveolar bone.

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Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

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