Major approaches to minimally traumatic surgery in dentistry: a systematic review

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Abstract

Introduction: It is estimated that in minimally traumatic dental surgery, synthesis studies with meta-analysis and decision analysis represent almost 29% of all studies. Most of the selected studies were carried out in the USA, Netherlands, and UK. These three countries and 15 journals accounted for nearly 50% of all publications. The remaining works were published in another 61 journals and originated from 32 other countries, including Brazil. Objective: This study aimed to demonstrate, through literature review and case reports, the evolution and consequent importance of improving minimally traumatic surgery techniques in dentistry. It was hypothesized that there were statistically significant results about advances in the attempt to minimize trauma. Methods: The research was carried out from July 2021 to October 2021 and developed based on Google Scholar, Scopus, PubMed, Scielo, and Cochrane Library. The inclusion and exclusion criteria were systematic review studies, meta-analysis, controlled and randomized cases, non-randomized clinical cases, and opinion articles, which addressed the term minimally traumatic surgery in dentistry. The quality of the studies was based on the GRADE instrument. 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. 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. Dental implants. Extraction.

Introduction

In minimally invasive or atraumatic surgery or dental procedures, there are about 245 clinical studies [1-4]. This selection of data was due to the significant increase in quantitative synthesis methods in the dental literature from the beginning of the 21st century [5]. Most of the selected studies were carried out in the USA, Netherlands, and UK. The remaining works were published in another 61 journals and originated from 32 other countries, including Brazil [5,6]. Thus, the studies were classified in the areas of periodontics, cardiology, implantology, endodontics,
orthodontics, oral pathology, maxillofacial surgery, prosthesis, and others [6,7]. However, the uncertainty is about the conclusions obtained from a set of studies on minimally traumatic surgery [5].

As a corollary, dental transplantation appears as an alternative treatment for all social strata, being called biological prosthesis [8]. Thus, the transfer of a natural tooth from its socket to another site is related to extensive caries, root resorption, periodontal disease, coronoradicular fracture, agenesis, and aplasia of teeth. The technique must be minimally traumatic 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 [8].

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 [8]. Immediate implants are those installed soon after the extraction of compromised roots or teeth, using, for this, the remaining alveolus to install the implant, minimizing trauma and optimizing treatment [8-10].

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 [8]. 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 [11]. 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 [5,8].

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 [5,8]. However, it is not a technique widely used by some specialists, although it is easily feasible and can provide great biological and aesthetic benefits [12].

This study aimed to demonstrate, through a literature review, the evolution and consequent importance of improving techniques for minimally traumatic surgeries in dentistry. It was hypothesized that there were statistically significant results about advances in the attempt to minimize trauma.

Methods

Study Design

The present study was followed by a systematic literature review model, according to the PRISMA rules [13].

Data sources and research strategy

The search strategies for this review were based on the descriptors “Minimally Traumatic Surgery, Implantology, Dental implants, and Extraction”. The research was carried out from July 2021 to October 2021 and developed based on Google Scholar, Scopus, PubMed, Scielo, and Cochrane Library. The inclusion and exclusion criteria were systematic review studies, meta-analysis, controlled and randomized cases, non-randomized clinical cases, and opinion articles, which addressed the term minimally traumatic surgery in dentistry.

Study quality and risk of bias

The quality of the studies was based on the GRADE instrument [14], with randomized controlled clinical studies, prospective controlled clinical studies, and studies of systematic review and meta-analysis listed the studies with the greatest scientific evidence. The risk of bias was analyzed according to the Cochrane instrument [15].

Results and Discussion

Figure 1 shows that out of a total of 167 articles found, 46 articles were evaluated and 18 were rejected for not meeting the GRADE classification, and only 28 articles were used in this study to compose the textual part. As literary support, a study evaluated the stability of immediate implant placement for alveolar bone augmentation and preservation with bovine bone graft after minimally traumatic tooth extraction. Therefore, the insertion of immediate implants in bovine bone extraction cavities 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 [1,2].

In this context, a randomized controlled study evaluated the resorption of the alveolar ridge using the “socket shield” (SST) technique without immediate placement of dental implants. This trial included 27 patients: 14 maxillary non molar teeth were partially extracted using the SST (test group) and 13 were extracted using a minimally traumatic extraction...
approach (control group). SST without immediate implant placement showed greater preservation of vestibulopalatal crest dimension and less preservation of vestibular wall thickness compared to minimally traumatic extraction. Furthermore, it provided superior maintenance of the basal height of the vestibular wall. Modified SST is a promising approach, but factors that interfere with the results must be investigated [16].

Besides, immediate implant placement (IIP) in fresh extraction sockets exhibits survival and success rates similar to late implant placement in healed sockets. Several advantages of IIP involve reducing the total treatment time, reducing the number of invasive surgeries, and subsequently reducing patient discomfort due to the lack of additional surgeries. The main deficiencies in IIP, however, include the inability to obtain early bone support, the presence of a gap between the extraction socket and the accessory, and the inability to cover the accessory with soft tissue, leading to an increased risk of infection and implant loss. When IIP is performed, atraumatic or minimally traumatic extractions, conservation of the septal bone in molars, minimal elevation of the flap or flapless surgery, bone grafting in the gap between the fixation and the extraction socket, and covering with soft tissue or membrane should be considered. [17].

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 [18].

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 in elderly patients to preserve the longevity of their natural dentition [19].

Thus, performing indiscriminate extractions, without the objective of immediate or delayed

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**Figure 1. The selection process of scientific articles.**
rehabilitation of the new prosthetic space, promote serious biological and social consequences generated by tooth loss without adequate rehabilitation [5]. Thus, as a result of 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 [20,21].

If the maintenance of the original tissue contours is respected, the chances of achieving good esthetic levels and acceptable functional conditions increase considerably. These cares are even more important and critical when the surgical act is performed in the anterior regions of the mouth [5]. The preservation of interproximal bone levels becomes 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 patient satisfaction [22].

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 if conventional prosthesis procedures and techniques or immediate implants with immediate esthetics, are used for the rehabilitation of the case [5,8,23].

Thus, 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 [3,24].

Furthermore, the atraumatic restorative treatment (ART) was developed by Frencken in Africa 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. About the partial removal of carious tissue, Imparato et al. (2010) cited the systematic review of the Cochrane Library by Ricketts et al. (2006) [25].

Furthermore, Barreto (2007) cited works by Van Amerogen (2003) and Deery (2005) that compared the psychological behavior of children when using ART to conventional treatment [7]. 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. As for Guedes-Pinto (2003), ART can work as a preparatory treatment for restorations, as it can eliminate the cariogenic microbiota within 48 h.

Still, 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 GIC can incorporate it again from toothpaste. However, the limitations regarding the use of the GIC 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, teamwork, good lighting, force control, knowledge of topographical anatomy, control of movements and gestures, search for a support point to reduce tremor, and decreased surgery time [27,28].

The basic rules that guide the doctrine of minimally traumatic surgical technique are tension-free surgeons, 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 swabs soaked in warm saline solution [29]. As proof, minimally traumatic extraction techniques have several advantages over conventional techniques currently performed, especially with regard to maintaining the integrity of the alveolar bone and attached gingiva. They consist of controlled techniques, with a high level of predictability [30].

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 anxiety of patients, greater acceptance by adults and children, lower cost, speed of execution, possibility of correcting the inadequate technique, good clinical performance in restorations of one face, possibility of performance in social spaces such as schools, day care
centers or at home [2,7,23,31].

**Conclusion**

It is concluded that, in the world and in Brazil, there have been several attempts to minimize the professional's 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.

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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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