



## Major clinical findings of minimally invasive surgery in dentistry: a systematic review

Maria Cecília Venâncio dos Reis<sup>1,2</sup>, Larissa Marson de Oliveira<sup>1,2</sup>, Patricia Dias dos Santos<sup>1,2</sup>, Elias Naim Kassis<sup>1,2</sup>

<sup>1</sup> UNORTE - University Center of Northern São Paulo - Dentistry department, Sao Jose do Rio Preto, Sao Paulo, Brazil.

<sup>2</sup> UNIPOS - Post graduate and continuing education, Dentistry department, Sao Jose do Rio Preto, Sao Paulo, Brazil.

\*Corresponding author: Larissa Marson de Oliveira.

Unorte/Unipos – Graduate and Postgraduate in dentistry, Sao Jose do Rio Preto, Sao Paulo, Brazil.

E-mail: larissamarson@hotmail.com.br

DOI: <https://doi.org/10.54448/mdnt22S309>

Received: 03-12-2022; Revised: 04-28-2022; Accepted: 04-28-2022; Published: 05-10-2022; MedNEXT-id: e22S309

### Abstract

**Introduction:** In the scenario of surgery or minimally invasive dental procedures there are more than 300 clinical studies. The studies were classified in the areas of periodontics, cardiology, implantology, endodontics, orthodontics, oral pathology, oral and maxillofacial surgery, prosthesis, and others. Uncertainty is about the conclusions obtained from a set of studies on minimally traumatic surgery. **Objective:** It was to demonstrate the evolution and consequent importance of improving minimally traumatic surgery techniques in dentistry. **Methods:** The present study followed a systematic review model, following the rules of systematic review – PRISMA. The search strategy was performed in the PubMed, Cochrane Library, Web of Science and Scopus, and Google Scholar databases. The present study was carried out from January to March 2022. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument. **Results:** A total of 121 articles were found. A total of 86 articles were fully evaluated and 27 were included in this study. 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 the inflammatory processes, edema, pain, and ecchymosis that can affect patients, in trans and postoperative periods. Thus, maximum preservation of the integrity of soft tissues (papilla and free and attached gingiva) adjacent to the prosthetic spaces should be sought, and preservation of the level of the alveolar bone ridge, minimizing surgical trauma. **Conclusion:** There are many 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, maximum preservation of the integrity of the soft tissues adjacent to the prosthetic spaces and the preservation of the level of the alveolar bone ridge should be sought to achieve the minimization of surgical trauma.

**Keywords:** Dental surgery. Minimally invasive surgery. Minimally invasive procedures. Clinical studies.

### Introduction

In the scenario of surgery or minimally invasive dental procedures, there are more than 300 clinical studies [1,2]. 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 [3,4]. Most of the selected studies were developed in the USA, Netherlands, and UK. The other works were published in other journals and originated from several countries, including Brazil [4,5].

Thus, the studies were classified in the areas of periodontics, cardiology, implantology, endodontics, orthodontics, oral pathology, oral and maxillofacial surgery, prosthesis, and others [5,6]. However, uncertainty is about the conclusions obtained from a set of studies on minimally traumatic surgery [4].

As a corollary, dental transplantation appears as an alternative treatment for all social strata, being called biological prosthesis [7]. Thus, the transfer of a natural tooth from its socket to another site is related to extensive caries, root resorption, periodontal disease, crown-root fracture, agenesis, and aplasia of teeth. The technique should be minimally invasive for a better prognosis of the tooth to be transplanted since the periodontal ligament should not be manipulated, as it is

necessary for the repair of periodontal tissues [7-9].

Also, with the increasing modernization of implantology, we have immediate implants as the procedure with the highest probability of success among oral cavity rehabilitation treatments, using osseointegrated implants [7]. Immediate implants are those installed right after the extraction of roots or compromised teeth, using the remaining socket itself for implant installation, minimizing trauma, and optimizing treatment [10,11].

Among the many advantages that immediate implants provide, there is good patient acceptance, and a reduction in the number of surgical interventions, in addition to limiting the resorption of the residual alveolar bone ridge [2,7]. In addition, there is the possibility of installing a temporary tooth in acrylic or light-curing resin, fixed on the newly installed implant, further reducing bone loss and preserving the gingival contour of the region, restoring aesthetics, smile and reintegration. social [3,12]. Thus, this procedure is called “immediate aesthetics” over the immediate implant. However, for results with a good critical level of significance, the implant must have a large part of the surface of its spirals anchored in healthy and natural bone [3,4,7].

Besides, a significant and useful procedure, directly associated with immediate implants, is the technique known as root burial, which allows for a proliferation of the attached gingiva sufficient to sometimes completely cover the socket after the immediate implant placement, without the need for total flap relaxation, if it does not receive a provisional tooth in the same implant installation session [7]. However, it is not a technique widely used by some specialists, although it is easily performed and can provide great biological and aesthetic benefits [13].

Therefore, the present systematic review study demonstrated the evolution and consequent importance of improving minimally traumatic surgery techniques in dentistry.

## Methods

### Study Design

The present study followed a systematic review model, following the rules of systematic review - PRISMA (Transparent reporting of systematic review and meta-analysis, access available in: <http://www.prisma-statement.org/>).

### Data Sources

The search strategy was performed in the PubMed, Cochrane Library, Web of Science and Scopus, and Google Scholar databases. The present study was carried out from January to March 2022.

### Descriptors (MeSH Terms)

The main descriptors (MeSH Terms) used were “Dental surgery. Minimally invasive surgery. Minimally invasive procedures. Clinical studies”. For greater specification, the description “bone regeneration” for refinement was added during the searches, following the rules of the word PICOS (Patient; Intervention; Control; Outcomes; Study Design).

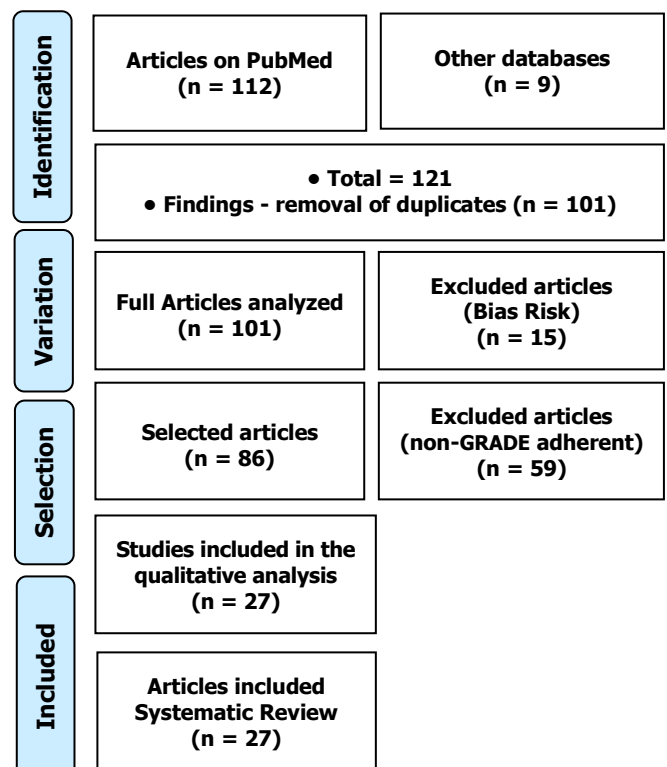
### Selection of studies and risk of bias in each study

Two independent reviewers (1 and 2) performed research and study selection. Data extraction was performed by reviewer 1 and fully reviewed by reviewer 2. A third investigator decided some conflicting points and made the final decision to choose the articles. Only studies reported in English were evaluated. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument.

## Results and Discussion

A total of 121 articles were found. Articles that presented low-quality scientific evidence according to GRADE, as well as articles that showed research biases, such as a low number of participants and dubious results were also excluded. A total of 86 articles were fully evaluated and 27 were included in this study (Figure 1).

Figure 1. Article selection (Systematic Review).



Based on the literary findings, it was found that one study evaluated the feasibility of a minimally invasive surgical technique for anterior maxillary distraction osteogenesis to correct maxillary hypoplasia in cleft patients. A modified Y distractor was placed intraorally in 106 patients with cleft-associated maxillary deficiency to facilitate maxillary protraction. Subsequently, the patients underwent anterior maxillary osteotomy through a minimally invasive incision, followed by activation of the device at a rate of 0.8 mm/day until a positive overjet was obtained. The patient's lateral cephalograms were evaluated preoperatively (T1), after activation (T2), and one year postoperatively (T3). A mean (SD) of 10.4 (2.58) mm of maxillary anterior advancement was achieved in all patients after 10-13 days of distraction. The saddle-nasion-point A angle (SNA) increased from 75.37° to 83.01°. When we compared cephalometric variables at T1 and T2, mean maxillary length and overjet at T2 were significantly higher. The comparison of mean values at T2 and T3 was not significant. Minimally invasive anterior maxillary distraction with the modified Y distractor resulted in consistent activation changes one year after surgery, making it a conservative, less traumatic, and effective treatment of cleft-related maxillary deficiency [14].

Also, one study evaluated the stability of immediate implant placement for alveolar bone augmentation and preservation with bovine bone graft after minimally invasive tooth extraction. Therefore, the insertion of immediate implants in extraction cavities with bovine bone with increased 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 [7].

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 time- and cost-effective procedure [15].

In this way, the application of the concepts of minimal intervention in dentistry and minimally invasive operative 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 [16].

Thus, performing extractions indiscriminately, without the objective of immediate or late rehabilitation

of the new prosthetic space, promotes serious biological and social consequences generated by tooth loss without adequate rehabilitation [4]. If the maintenance of the original tissue contours is respected, the chances of achieving good aesthetic levels and acceptable functional frameworks increase considerably. These precautions are even more important and critical when the surgery is performed in the anterior regions of the mouth [4].

Thus, as a result of the enormous advance of minimally invasive techniques and the diffusion of modern implantology and the level of safety of the treatment provided by it, in addition to the refined techniques of making conventional prostheses that are relatively safe if planned correctly, the patient can have an adequate rehabilitation. with various techniques [17,18].

The preservation of the interproximal bone levels becomes essential for the maintenance of 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 [19].

Likewise, the preservation of bone and gingival integrity can drastically reduce the volumes of drugs administered in the postoperative period and facilitate the creation of adequate profiles and contours of provisionals for gingival conditioning, even with conventional prosthetic procedures and techniques or immediate implants. with immediate esthetics, are used for the rehabilitation of the case [24,7,20].

Thus, since the most primordial extraction techniques were created and developed, there have been several attempts to minimize the professional's effort, reduce surgical time and alleviate bleeding and the inflammatory processes, edema, pain, and ecchymosis that can affect patients, in the trans and postoperative periods. Thus, maximum preservation of the integrity of the soft tissues (papilla and free and attached gingiva) adjacent to the prosthetic spaces should be sought; preservation of the level of the alveolar bone ridge [4,21].

Furthermore, atraumatic restorative treatment (ART) was developed by Frencken in Africa to control the progression of caries. The main functions of ART are the preservation of the tooth structure with minimal operative intervention, reduction of endodontic treatment or exodontia, and reduction of patient discomfort due to the lack of local anesthesia. About partial removal of carious tissue [22].

Furthermore, Barreto (2007) cited works by Van Amerongen (2003) and Deery (2005) who compared the psychological behavior of children when using ART to conventional treatment [6]. Heart rate was monitored

throughout the procedures and the researchers concluded that the manual instruments in the atraumatic treatments caused less discomfort and anxiety than the rotary instruments of the conventional technique. Furthermore, TRA can work as a preparatory treatment for restorations, as it can eliminate the cariogenic microbiota within 48 h [2].

Furthermore, glass ionomer cement (GIC) is widely used in dentistry for its cariostatic effect, due to the release of fluoride in the most superficial layers of restorations [23]. Also, in addition to releasing fluoride, GICs can re-incorporate it from toothpaste. However, limitations regarding the use of the GIC are related to its physical properties and aesthetic limitations. GICs have low cohesive strength and wear, limiting their use for single-sided restorations, in addition to suffering syneresis and embedding [23].

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 achieved through good surgery planning, working together, good lighting, force control, knowledge of topographical anatomy, control of movements and gestures, search for a point of support to reduce tremors, and decrease in surgery time [24,25].

The basic rules that guide the doctrine of minimally invasive surgical technique are tension-free surgeons, minimal and precise movements, dissecting only what is essential, reducing tissue exposure to a minimum, gentle manipulation, use of correct instruments and techniques, use of compresses soaked in warm saline solution [26].

As evidence, minimally invasive tooth 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 [27].

However, the controlled avulsion extraction technique can be considered the most predictable, guaranteeing maximum integrity of the alveolar bone wall, drastically reducing bleeding and, mainly, the procedure time. Among the contraindications observed in this type of technique performed with 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 to install metallic cores, among others. However, some of the innovations that are being developed exclusively for the Xt Lifting® system have emerged with great success, in order to

ensure the performance of minimally invasive tooth extractions in a wider range of clinical situations [27].

Besides, when it comes to cardiology, there is the atraumatic restorative treatment (ART) that provides a glimpse of several minimally traumatic treatment options, depending on factors such as aesthetics, tooth function, patient expectations, cost of restoration, and optimization of surgical techniques. Thus, authors such as Frencken and Holmgren (2001) [20], and Barreto (2007) [6] listed the advantages of ART, such as greater preservation of tooth structure, curative and preventive technique in a single procedure, preservation of the innermost dentin, reduced trauma, lower risk of pain, no need for anesthesia, decreased patient anxiety, greater acceptance by adults and children, lower cost, speed of execution, the possibility of correcting inadequate technique, good clinical performance in restorations of a single face, the possibility of execution in social spaces, such as schools, daycare centers or at home.

## Conclusion

It was concluded that in the world and in Brazil, there have been several attempts to minimize the effort of the professional, reduce the surgical time and alleviate the bleeding and the inflammatory processes, edema, pain, and ecchymosis that can affect patients. Thus, maximum preservation of the integrity of the soft tissues adjacent to the prosthetic spaces and the preservation of the level of the alveolar bone ridge should be sought to achieve the minimization of surgical trauma.

## Acknowledgement

Not applicable.

## Funding

Not applicable.

## Ethics approval

Not applicable.

## Informed consent

Not applicable.

## Data sharing statement

No additional data are available.

## Conflict of interest

The authors declare no conflict of interest.

## Similarity check

It was applied by Ithenticate@.

## About the License

© The authors (s) 2022. The text of this article is open access and licensed under a Creative Commons Attribution 4.0 International License.

## References

1. Lee W. Immediate implant placement in fresh extraction sockets. *J Korean Assoc Oral Maxillofac Surg.* 2021 Feb 28;47(1):57-61. doi: 10.5125/jkaoms.2021.47.1.57. PMID: 33632979; PMCID: PMC7925164.
2. Koshy E, Annamma LM, George BT, Menezes GA. The retrieval of a surgical blade broken within the alveolar bone during minimally traumatic tooth extraction. *BMJ Case Rep.* 2021 Jan 27;14(1):e240162. doi: 10.1136/bcr-2020-240162. PMID: 33504539; PMCID: PMC7843332.
3. Faciola Pessôa de Oliveira PG, Pedroso Bergamo ET, Bordin D, Arbex L, Konrad D, Gil LF, Neiva R, Tovar N, Witek L, Coelho PG. Ridge Architecture Preservation Following Minimally Traumatic Exodontia Techniques and Guided Tissue Regeneration. *Implant Dent.* 2019 Aug;28(4):319-328. doi: 10.1097/ID.0000000000000886. PMID: 31008823.
4. Al Qabbani A, Al Kawas S, EneZEI H, Razak NHA, AL Bayatti SW, Samsudin AR, Hamid SAB. Biomechanical and radiological assessment of immediate implants for alveolar ridge preservation. *Dent Res J (Isfahan).* 15(6):420-429, 2018.
5. Amorim R.E.; Leal S.C.; Frencken J.E. Survival of atraumatic restorative treatment (ART) sealants and restorations: a meta-analysis. *Clin Oral Invest,* 2011.
6. Barreto, V.C. Avaliação das restaurações minimamente invasivas em pré-escolares. Dissertação (mestrado)-Universidade Federal do Rio Grande do Sul. Faculdade de odontologia. Porto Alegre, 2007.
7. Krug R, Connert T, Soliman S, Syfrig B, Dietrich T, Krastl G. Surgical extrusion with an atraumatic extraction system: A clinical study. *J Prosthet Dent.* 120(6):879-885, 2018 [doi: 10.1016/j.prosdent.2018.02.006. Epub 2018 Jun 28].
8. Brasil. Ministério da saúde / Conselho Nacional de Saúde. Documento base da III Conferência Nacional de Saúde Bucal: acesso e qualidade, superando a exclusão social. Brasília, 2004.
9. Cardoso AC. O Passo-a-Passo da Prótese Sobre Implante. Ed. Santos, 1ª ed, 2005.
10. Carvalho PS. Gerenciando os Riscos e Complicações em Implantodontia. Ed. Santos. São Paulo, 2007.
11. Carvalho, L.S. Tratamento restaurador atraumático em cavidades atípicas. *Revista Gaúcha de Odontologia.* Porto Alegre, v.57, n.3, 357-362, 2009.
12. Coato AM GW, Mariotti A. Immediate placement of anatomically shaped dental implants. *J Oral Implantol;* 26:170-176, 2000.
13. Colares, V.; Franca, C.; Amorin F.H.A. O tratamento restaurador atraumático nas dentições decídua e permanente. *Revista Portuguesa de Estomatologia, Medicina Dentária e Cirurgia Maxilofacial.* V. 50, n.1, 35-41, 2009.
14. Shetty V, P NK, Khanum A, Yadav A, Sailer HF. Minimally-invasive anterior maxillary distraction technique in patients with cleft lip and palate and maxillary deficiency: an evaluation of 106 patients. *Br J Oral Maxillofac Surg.* 2020 Sep;58(7):777-783. doi: 10.1016/j.bjoms.2020.03.026. Epub 2020 Jun 4. PMID: 32507641.
15. Iraqui O, Lakhssassi N, Berrada S, Merzouk N. Atraumatic bone expansion: Interest of piezo-surgery, conicals expanders and immediate implantation combination. *Rev Stomatol Chir Maxillofac Chir Orale.* 117(3):151-7, 2016 [doi: 10.1016/j.revsto.2016.04.002. Epub 2016 May 12].
16. Hayes M, Allen E, DA Mata C, Mckenna G, Burke F. Minimal intervention dentistry and older patients part 2: minimally invasive operative interventions. *Dent Update.* 41(6):500-2, 504-5, 2014.
17. Cooper LF, Rahman A, Moriarty J. Immediate mandibular rehabilitation with endosseous implants: simultaneous extraction, implant placement, and loading. *Int J Oral Maxillofac Implants;*17:517-525, 2002.
18. Covani V, Crespi R, Cornolini R, Barone A. Immediate implants supporting single-crown restoration: a 4 year prospective study. *J Periodontol;* 75:982-988, 2004.
19. Foschetti JHM. Tratamento restaurador atraumático associado a medidas preventivas na saúde pública brasileira. Trabalho de conclusão de curso (Especialização) – Universidade Federal de Minas Gerais, 2010.
20. Frencken JE, Holmgren CJ. Tratamento

restaurador atraumático para a cárie dentária. São Paulo. Santos Editora, 2001.

21. Gomes AC. Tratamento restaurador atraumático como alternativa de tratamento em bebês portadores de fissura, relato de caso clínico. *Revista Odontológica de Araçatuba*, v.24, n.2, 52-55, 2003.
22. Groisman M, Frossard WM, Ferreira HM, DE Menezes FLM, Touati B. Single-tooth implants in the maxillary incisor region with immediate provisionalization: 2-year prospective study. *Pract Proced Aesthet Dent*;15:115-122, 2003.
23. Irinakis T. Rationale for socket preservation after extraction of a single-rooted tooth when planning for future implant placement. *J Can Dent Assoc*;72:917-922, 2007.
24. Jahangiri L, Devlin H, Ting K, Nishimura I. Current perspectives in residual ridge remodeling and its clinical implications: a review. *J Prosthet Dent*; 80:224-37, 1998.
25. Wheeler SL, Vogel RE, Casellini R. Tissue preservation and maintenance of optimum esthetics: a clinical report. *Int J Oral Maxillofac Implants*;15:265-271, 2000.
26. Kan JY, Rungcharassaeng K, Lozada J. Immediate placement and provisionalization of maxillary anterior single implants: 1-year prospective study. *Int J Oral Maxillofac Implants*;18:31-39, 2003.
27. Vescovi P, Campisi G, Fusco V, Mergoni G, Manfredi M, Merigo. Surgery-triggered and non surgery-triggered bisphosphonate-related osteonecrosis of the jaws (BRONJ): a retrospective analysis of 567 cases in an Italian multicenter study. *Oral Oncol* 47:191-194, 2011.