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In Lately, the importance of periimplant tissue has become increasingly evident in implant dentistry. Until the early 2000s, researchers and clinicians focused exclusively on the interaction between the bone and implant. Thereafter, the main focus became esthetics and the key role of the muco-prosthetic framework in relation to it. During the subsequent period, clinicians have focused their attention on the soft-tissue volume increment around implant-supported restorations, to achieve a more stable and esthetic result.

It is useless to talk about the importance of keratinized tissue or an adequate amount of connective tissue to improve the emergence profile of an implant-supported restoration in the esthetic zone. However, often soft-tissue grafts were done following the notion of the more, the better and the scientifically unconfirmed guarantee of a “periodontal-like” attachment between the abutment and the tissue, whatever material the abutment was made of. This was done without considering the high risk of creating a pocket all around the prosthesis.

Very recently, for this reason, attention in implant dentistry was focused mostly on the interaction between the abutment and the connective tissue, and the greatest attention was centered on the abutment’s ability to adhere to soft tissue, to “fibro-integrate”. This is a dramatic change of perspective because it implies a shift of attention from the bulk material, or the macroscopic geometry of the abutment, to its external microcharacteristics: cleanliness, electric properties, microtexture, wettability.

Maybe the near future will bring us a material (or configuration) that is truly integrable with soft-tissue.

Dr. Luigi Canullo
Associate editor
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Trends in clinical trials on bone regeneration in dentistry—towards an innovative development in dental implant treatment

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Abstract

Objective
The aim of this study was to assess the global trends in clinical trials on bone regeneration in dental implantology.

Materials and methods
An electronic search for clinical studies was conducted via the ClinicalTrials.gov database. The search strategy used the following terms: “bone regeneration” AND “oral,” and “bone regeneration” AND “dental.” Furthermore, the selected clinical studies were resurveyed using “bone regeneration” AND “dental implant,” and “bone regeneration” AND “oral” AND “implant” for further analysis.

Results
We selected 181 clinical studies related to the field of bone regeneration in dentistry from ClinicalTrials.gov. The selected studies were conducted in 27 countries from 2001 to the present, and the total number of studies has been increasing since 2011. Analysis of the clinical stage revealed a higher ratio (55.6%) of early study phases (early phase 1, phase 1, phase 1/2 and phase 2), but the periodontal field of application appeared more mature, having more phase 4 trials. Regarding the bone regeneration methods for dental implantology, the major technique examined in interventional clinical trials was guided bone regeneration, followed by alveolar ridge preservation, and sinus floor elevation. Various grafting materials, such as autografts, allografts, xenografts, alloplasts and barrier membranes, were examined to determine clinical efficacy. Combinations of these materials were more frequently used.

Conclusion
Our analysis of the clinical trials registered on the ClinicalTrials.gov database indicated the global clinical trends in bone regeneration techniques in dentistry. The randomized clinical trials of guided bone regeneration technique using combination of different bone grafts materials is conducted the most in dental implantology. These findings could be useful for development of an innovative therapy for bone regeneration.

Keywords: Bone regeneration; clinical trials; ClinicalTrials.gov; dental implants; regenerative medicine.
Introduction

A clinical trial is a study in humans that assesses safety and effectiveness of a new treatment. It is essential to develop new treatment for therapeutic use. It is clearly crucial to conduct clinical trials and log the relevant information on a database for development of novel medicine. During the 1990s, clinical trial registration was strongly promoted in biomedical research, with the aim of documenting the existence of all trials and eliminating publication bias. The International Committee of Medical Journal Editors required registration of all trials starting enrollment after July 1, 2005, and of ongoing clinical trials that began enrolling patients before that date. The World Health Organization declared support for clinical trial registration and in 2006 launched the WHO International Clinical Trials Registry Platform (ICTRP). The Clinical Trials Search Portal provides access to a central database containing the trial registration datasets. Currently, there are 17 data providers of the ICTRP Search Portal, including ClinicalTrials.gov, the EU Clinical Trials Register, the ISRCTN registry, the Japan Primary Registries Network, the Australian New Zealand Clinical Trials Registry, the Brazilian Clinical Trials Registry and the Chinese Clinical Trial Register (https://www.who.int/ictrp/search/data_providers/en/).

ClinicalTrials.gov is a database of privately and publicly funded clinical studies conducted around the world and is the world’s largest clinical trial registration database. It is hosted by the National Library of Medicine at the National Institutes of Health in collaboration with the U.S. Food and Drug Administration. It explores 321,732 research studies in 209 countries and provides information about target diseases, sponsors, principal investigators, planned schedules and protocols, and enrollment. Moreover, since the database provides comprehensive information on the content of the planned clinical trials, one can perform various targeted analyses by extracting and tagging attribute data from each clinical study plan.

Alveolar bone loss is often caused by trauma, pathology, chronic or acute infections, severe periodontitis, and loss of mechanical function after tooth extraction or tooth loss. Since the overall alveolar changes after tooth extraction may compromise prosthodontic rehabilitation using tooth-supported fixed or removable prostheses, as well as implant-supported prostheses, adequate quality and quantity of bone regeneration are required, especially in the field of implant dentistry. Various materials and surgical treatments have been developed, but a definitive bone regeneration technique is not yet established. To the best of our knowledge, there are no scientific reports that have comprehensively analyzed and examined the clinical research trends in bone regeneration in dental implant treatment.

In this article, the focus was on bone regeneration for an innovative development in dental implant treatment based on the clinical trials registration database. Since ClinicalTrials.gov is the largest clinical trial registration database in the world and is one of the best designed database providers for aggregation and analysis, we chose it to obtain the data for analysis. In this concise review, we first surveyed country, start year and clinical stage of clinical studies on bone regeneration in dentistry to identify global translational trends and followed this with analysis of the details about clinical trials in dental implantology. We aimed to establish global translational trends, which have thus far been difficult to interpret. The results of this study could be useful to learn of the development of new techniques in dental implantology.

Materials and methods

In this review, an extensive electronic search for clinical studies was conducted via the ClinicalTrials.gov database. The last search was updated on Nov. 11, 2019. Medical Subject Headings, combined with free words, was used to identify the search terms. The following search terms: “bone regeneration” AND “oral,” and “bone regeneration” AND “dental” were used for analysis by country, start year and clinical stage of the clinical studies. In this survey, we excluded duplicate studies and in vitro or preclinical studies using human subjects. In clinical stage analysis, the studies that were described as “not applicable” in the database were excluded. Furthermore, the selected clinical studies were resurveyed using “bone regeneration” AND “oral,” and “bone regeneration” AND “dental” AND “implant.” We excluded studies that were not related to bone regeneration by reading the descriptions of the individual studies.
Trends in clinical trials on bone regeneration

Fig. 1

Fig. 2
Results

We first surveyed ClinicalTrials.gov to identify translational trends in bone regeneration in dentistry. Initially, 181 studies were selected through a primary database search. After excluding duplicate studies, 144 studies remained. We excluded in vitro or preclinical studies using human subjects by carefully reading the descriptions of the individual studies, and 142 studies were used for their content for analysis. First, we classified the entire list of clinical studies on bone regeneration in dentistry by country (Fig. 1). The selected clinical studies were conducted in 27 countries, and the major country was the U.S. (32 studies), followed by Egypt (24 studies), Brazil (10 studies), India (10 studies), and Italy (10 studies).

In order to analyze the clinical research trends regarding bone regeneration in dentistry, the selected studies were sorted by start year (Fig. 2). This analysis showed that bone regeneration therapy was performed in dentistry from 2001 to the present. The first study was a clinical trial on periodontal tissue regeneration using fibroblast growth factor-2 conducted in Japan. The total number of studies has been increasing since 2011. The clinical studies were classified according to their current status. Some studies were withdrawn and the reasons given were the following “Principal investigator and sponsor did not reach an agreement,” “Lack of pediatric recruitment ability,” “Administrative changes precluded enrollment,” and “It was not approved by IRB [institutional review board].”

To determine progress in testing novel methods of bone regeneration in dentistry, the clinical stage was analyzed (Fig. 3). Among the selected studies, 79 studies were not applicable. Early phase 1, phase 1, phase 1/2 and phase 2 studies made up 55.6% of bone regeneration studies in dentistry. There were 17 phase 4 clinical trials, 9 of which were conducted in order to evaluate the efficacy of various products in the treatment of periodontal bone defects. The products

![Fig. 3](image-url)
used in periodontal treatment were as follows: atorvastatin gel, biological amniotic membrane, rosuvastatin, decalcified freeze-dried bone allograft and cerabone bone (botiss biomaterials), alendronate, simvastatin gel, amnion–chorion allograft membrane, and biphasic calcium phosphate (Straumann BoneCeramic, Straumann) combined with enamel matrix proteins (Straumann Emdogain, Straumann). Guided bone regeneration (GBR) using autografts (autogenous dental graft), allografts (enCore Combination Allograft

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**Fig. 4**

A. Trends in clinical trials on bone regeneration

![Pie chart showing observational and interventional studies](image)

- Observational: 16
- Randomized parallel assignment: 2
- Randomized sequential assignment: 2
- Nonrandomized parallel assignment: 1
- Single-group assignment: 0

B. Distribution of treatments used in clinical trials

![Pie chart showing treatment distribution](image)

- GBR: 57%
- ARP: 24%
- SFE: 14%
- Others: 5%
In the next step, we focused on bone regeneration studies in patients requiring dental implant placement. Twenty-four studies were selected through a database search, and 1 study was excluded because the technique was aimed at periimplantitis treatment not bone regeneration. In total, 23 studies were used for the analyses. The number of clinical studies according to study design is shown in Figure 4A. Most of them were interventional studies (21 studies). An overview of the interventional clinical trials on bone regeneration in dental implantology is shown in Table 1. Among these interventional studies, 16 were parallel design randomized controlled trials. Regarding the bone regeneration methods, the major technique examined in interventional clinical trials was GBR (12 studies), followed by alveolar ridge preservation (ARP; 5 studies), and sinus floor elevation (SFE; 3 studies; Fig. 4B). The characteristics of the interventions are shown in Table 2. The results indicated that various grafting materials and procedures were examined to determine clinical efficacy. The grafting materials included autografts (bone marrow-derived cells, dentinal graft and platelet-rich fibrin), allografts (freeze-dried bone allograft, cortico-cancellous allogenic block [PHOENIX, TBF] and MinerOss [BioHorizons], xenografts [deproteinized bovine bone mineral [Geistlich Bio-Oss]), and alloplasts (biphasic calcium sulfate [BONDBONE, MIS Implant Technologies], calcium phosphosilicate alloplastic bone and nanocrystalline synthetic hydroxyapatite [NanoBone, ARTOSS]). Combinations of these materials were more frequently used (5 studies). The usefulness of membranes was also examined for the GBR and ARP techniques.

Discussion

In general, a new treatment should go through several procedures before it will be approved for therapeutic use. After tests and treatments are assessed in preclinical research, they go through a series of clinical trials in humans. To date, there are no clear reports on comprehensive clinical development trends in specific fields of regenerative medicine using a clinical trial registry. In this study, we focused on bone regeneration in dentistry, especially in dental implantology, based on the data obtained from ClinicalTrials.gov. We used data available on the ClinicalTrials.gov registry as the primary source in order to conduct comprehensive and chronological research, classification and analysis of clinical trials registered in this field, including assessing global research trends in bone regeneration. The clinical trials were conducted all over the world. Although ClinicalTrials.gov is the most global database in the world, there are other data providers. Since clinical trials tend to be registered in the database of their own country, many studies in the U.S. might be registered on ClinicalTrials.gov, but fewer studies in Japan, Australia or Germany, among others, might be registered.

Generally, clinical trials have 4 phases: phases 1–4. Phase 0/early phase 1 has been introduced to assist in eliminating ineffective products early in the development process and is not considered to replace formal phase 1 safety and tolerance studies. Phase 1 trials may involve the first administration to humans, usually to small numbers of healthy volunteers or to patients, in order to test safety and tolerance. If a new treatment is found to be reasonably safe in a phase 1 clinical trial, it can then be tested in a phase 2 clinical trial to find out whether it works. Phase 2 trials may be undertaken in a larger group of human patients to further assess safety and efficacy. Treatments that have been shown to work in phase 2 studies usually must succeed in 1 more phase of testing (phase 3) before they are approved for general use. Phase 3 trials usually involve a large group of patients, in order to compare the safety and effectiveness of the new treatment against the current standard treatment. When a phase 3 clinical trial (or sometimes a phase 2 trial) shows that a new treatment is more effective and/or safer than the current standard one, it can be submitted for approval. Our results indicated a higher ratio of early study phases (early phase 1, phase 1, phase 1/2 and phase 2) in the field of bone regeneration. The periodontal field of application appeared more mature, having more phase 4 studies. In the U.S., more than 47% people ≥ 30 years of age have periodontal disease, and the prevalence increases to 70% among those of ≥ 65 years of age. A similar trend is found in other countries. Since there is a strong need for periodontal treatment, clinical trials in periodontitis might be accelerated.
<table>
<thead>
<tr>
<th>Study design</th>
<th>NCT no.</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randomized parallel assignment</td>
<td>NCT00755911</td>
<td>Socket preservation with bone marrow-derived tissue repair cell therapy plus Gelfoam carrier (Pfizer) or only Gelfoam carrier</td>
</tr>
<tr>
<td></td>
<td>NCT00900718</td>
<td>Socket preservation with synthetic bone grafting material (Straumann Bone Ceramic) or DBBM (Bio-Oss)</td>
</tr>
<tr>
<td></td>
<td>NCT01012921</td>
<td>GBR§ with PEG†† membrane (Straumann MembraGel, Straumann) or standard collagen membrane (Bio-Gide)</td>
</tr>
<tr>
<td></td>
<td>NCT01572298</td>
<td>GBR with allograft (MinerOss) alone or with autograft and allograft</td>
</tr>
<tr>
<td></td>
<td>NCT01603693</td>
<td>DBBM (Bio-Oss) alone or in combination with biphasic calcium sulfate (BONDBONE)</td>
</tr>
<tr>
<td></td>
<td>NCT01616953</td>
<td>Alveolar defects secondary to clefts or trauma, autogenous bone grafting or bone marrow-derived cell therapy</td>
</tr>
<tr>
<td></td>
<td>NCT01628367</td>
<td>GBR around dental implants placed in fresh extraction sockets with or without nonresorbable PTFE membrane</td>
</tr>
<tr>
<td></td>
<td>NCT01942304</td>
<td>Sinus augmentation with calcium phosphosilicate alloplastic bone putty or anorganic bovine bone mineral</td>
</tr>
<tr>
<td></td>
<td>NCT02613663</td>
<td>Immediate implant using nanocrystalline hydroxyapatite (NanoBone) or autogenous bone</td>
</tr>
<tr>
<td></td>
<td>NCT03179683</td>
<td>Bilateral sinus lift and simultaneous dental implant placement with diode laser application</td>
</tr>
<tr>
<td></td>
<td>NCT03302143</td>
<td>GBR with autogenous bone and DBBM (Bio-Oss) or GBR with freeze-dried bone allograft</td>
</tr>
<tr>
<td></td>
<td>NCT03432702</td>
<td>Horizontal ridge augmentation using GBR with or without autogenous block graft</td>
</tr>
<tr>
<td></td>
<td>NCT03785717</td>
<td>Horizontal guide bone regeneration with or without shock waves</td>
</tr>
<tr>
<td></td>
<td>NCT03946020</td>
<td>GBR with DBBM (Bio-Oss) in combination with autogenous bone or DBBM alone</td>
</tr>
<tr>
<td></td>
<td>NCT04131894</td>
<td>Socket preservation with autogenous dentinal graft or mixture of PRF‡‡ and autogenous dentinal graft or empty as control</td>
</tr>
<tr>
<td></td>
<td>NCT04133090</td>
<td>Injectable PRF-enriched allograft material or autogenous block bone graft</td>
</tr>
<tr>
<td>Randomized sequential assignment</td>
<td>NCT03290638</td>
<td>Socket preservation with dehydrated human amnion–chorion membrane or type I bovine collagen membrane</td>
</tr>
</tbody>
</table>

Table 1 → continues on the next page
Trends in clinical trials on bone regeneration

<table>
<thead>
<tr>
<th>Study design</th>
<th>NCT† no.</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonrandomized parallel assignment</td>
<td>NCT00163605</td>
<td>Sinus lift procedures with bone substitute macroporous biphasic calcium phosphate fibrin sealant vapor-heated solvent/detergent treated 4 IU/mL thrombin</td>
</tr>
<tr>
<td></td>
<td>NCT03357705</td>
<td>Alveolar ridge preservation with nanocrystalline synthetic hydroxyapatite or bovine collagen sponge</td>
</tr>
<tr>
<td>Single-group assignment</td>
<td>NCT03076138</td>
<td>Gene-activated bone substitute consisting of octacalcium phosphate and plasmid DNA encoding VEGF§§ for maxillofacial bone regeneration</td>
</tr>
<tr>
<td></td>
<td>NCT03879967</td>
<td>Alveolar ridge augmentation with cortico-cancellous allogeneic blocks (PHOENIX) and autogenous chips and demineralized bovine bone (Bio-Oss)</td>
</tr>
</tbody>
</table>

† DBBM = deproteinized bovine bone mineral.  
§ GBR = guided bone regeneration.  
†† PEG = polyethylene glycol.  
‡‡ PRF = platelet-rich fibrin.  
§§ VEGF = vascular endothelial growth factor.

Table 1: Overview of clinical trials on bone regeneration in dental implantology.

<table>
<thead>
<tr>
<th>Graft type</th>
<th>GBR†</th>
<th>ARP‡</th>
<th>SFE§</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autografts</td>
<td>1</td>
<td>2</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>Allografts</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Alloplasts</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>Autografts + allografts</td>
<td>2</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Autografts + xenografts</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Xenografts + alloplasts</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Autografts + allografts + xenografts</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Membranes</td>
<td>2</td>
<td>1</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Others</td>
<td>2</td>
<td>–</td>
<td>1</td>
<td>–</td>
</tr>
</tbody>
</table>

† GBR = guided bone regeneration.  
‡ ARP = alveolar ridge preservation.  
§ SFE = sinus floor elevation.

Table 2: Characteristics of interventions.
A randomized controlled clinical trial is a study design that uses control patients who receive no treatment, the conventional treatment or a placebo. Randomization is the best way of ensuring that the results of trials are not biased by the way participants in each group are selected, so randomized controlled trials are the most reliable way to compare treatments. In this study, of the 23 trials on bone regeneration in dental implantology screened, 21 studies were interventional studies, 17 of which employed randomized assignment. The results indicated that the rate of randomized assignment was high (73.9%) in dental implantology studies.

Loss of bone width and depth can affect how successful the implant will be. In order to regenerate adequate bone volume for dental implant placement, the GBR technique is often performed. Most studies aiming for lateral bone augmentation have used the principles of GBR by combining different bone grafts and barrier membranes. However, the ideal graft or membrane material remains unclear. The results of our study indicated that 57% of interventional clinical trials on bone regeneration in dental implantology (12 studies) used the GBR technique. Most studies on GBR treatment (41.7%) combined different bone grafts: autografts and allografts; autografts and xenografts; xenografts and alloplasts; and autografts, allografts and xenografts.

In humans, approximately 50% of the bone volume is lost after tooth extraction during the first year. The alveolar bone resorption may not allow optimal positioning of dental implants. Maxillary sinus floor augmentation via SFE is a surgical procedure to gain the bone mass required in order to place dental implants. There is consensus that some threshold of osseous deficiency, vertical, horizontal or both, exists at a site where a sinus bone graft is required for successful implant treatment regardless of residual bone quality. Although this procedure is considered safe, various complications may arise during or after the surgery, such as perforation of the sinus membrane. ARP is performed after tooth extraction in an attempt to maintain the alveolar ridge height and width. ARP is a less invasive technique than SFE. The results of this study showed that the start dates of SFE clinical trials were from 2004 to 2013, whereas those of ARP studies were from 2006 to 2017. These results indicated a shift from SFE to ARP for bone regeneration in dental implantology.

In this study, we utilized the most global clinical trial database, ClinicalTrials.gov, to capture the largest trends in bone regeneration studies in dental implantology. The limitation of this study is that registered trials make up only a part of all existing trials. It has been suggested that only 50% of clinical studies indexed in PubMed that involved administration of cells for regenerative medicine indicated any clinical trial identifier. In addition, since ClinicalTrials.gov does not provide comprehensive results of clinical trials, it is impossible to analyze the results of the trials themselves.

**Conclusion**

In conclusion, these results on clinical trials registered on the ClinicalTrials.gov registration site showed the global trends in clinical trials on bone regeneration in implant dentistry. ClinicalTrials.gov, a publicly accessible database, is useful for detailed characterization and analysis of clinical trials. This study revealed that the periodontal field of application was more accelerated, having more phase 4 studies. As for implant dentistry, the most frequently conducted study was the randomized clinical trials of GBR technique using combination of different bone grafts materials. The present study has potential implications for understanding the clinical trends in the development of therapeutic bone regeneration techniques in dental implantology. In the future, further studies would be needed for further development of an innovative therapy in dental implant treatment.

**Competing interests**

The authors declare that they have no competing interests.

**Figure legends**

Fig. 1 – The number of clinical trials on bone regeneration in dentistry according to country.

Fig. 2 – The number of clinical trials on bone regeneration in dentistry according to start year. The current status of the studies is also color-coded.

Fig. 3 – Phases of clinical trials on bone regeneration in dentistry.

Fig. 4 – Study design (A) and bone regeneration method (B) of clinical trials on bone regeneration in
dental implantology. GBR = guided bone regeneration; ARP = alveolar ridge preservation; SFE = sinus floor elevation.

References


Gingivoplasty and botulinum toxin application result in improvement of severe gummy smile

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Abstract

Background
Currently, the search for esthetic excellence has become the main objective in dental treatment. Gummy smile is among patients’ complaints, since this condition may influence their self-esteem and social relationships. The development of new techniques such as the application of botulinum toxin may offer more conservative therapeutic options for the treatment of gummy smile.

Case presentation
A patient with dentogingival discrepancy and severe gummy smile was treated with gingivoplasty and application of botulinum toxin in order to optimize the harmony of the smile. The result was satisfactory regarding the harmony of the smile by combination of the treatments. The use of each of these treatments alone could not have achieved the excellence of the result. Initially, the creation of the new gingival zenith after gingivoplasty promoted the new dental architecture, favoring gingival, dental and facial harmony for the patient. Subsequently, the application of botulinum toxin reduced the gummy smile, by the uniform descent of the upper lip, smoothing the facial lines of the smile, as could be seen in the nasolabial folds, adjacent to the nostrils.

Keywords: Botulinum toxin type A; gingival overgrowth; gingivectomy; gingivoplasty; gummy smile; surgical crown lengthening.

Introduction
The demand for esthetic procedures has grown exponentially. Dental and medical procedures, besides pursuing the principle of promoting health, seek to achieve smile esthetics.1–3 Facial esthetic harmony is formed by the union of 3 components: teeth, gingiva and lips.1–4 The smile becomes esthetically pleasing when these elements are arranged in suitable proportion and gingival exposure is limited to 3 mm. When gingival exposure is larger than 3 mm, it characterizes a nonesthetic condition called gummy smile, which affects some patients psychologically.1, 5–7

Several therapeutic modalities have been proposed for the correction of gummy smile, among them are gingivoplasty,1–7 myectomy6 and orthognathic surgery.6–8
The last 2 procedures are more invasive and present high morbidity. However, the use of botulinum toxin can be considered a therapeutic alternative to the larger surgical procedure, as it is a more conservative and effective, faster and safer method compared with surgical procedures.

Botulinum toxin is synthesized by the anaerobic Gram-positive Clostridium botulinum bacterium and inhibits the release of acetylcholine at the neuromuscular junction, impeding muscular contraction. There are 7 distinct serotypes of the toxin, and type A is the most frequently used clinically and is a stronger subtype. Botulinum toxin has shown efficiency in the treatment of gummy smile, as well as of other disorders, such as temporomandibular dysfunction (bruxism, clenching and masstetic hypertrophy), sialorrhea, facial palsy and orofacial pain. The purpose of this article is to report a case of a patient who presented with severe gummy smile and was treated by a combination of gingivoplasty and botulinum toxin.
Case report

A 36-year-old female patient attended the clinic complaining of gummy smile (Fig. 1). Clinically, the patient presented with an anatomic discrepancy of more than 4 mm between the length of the maxillary teeth (Figs. 2 & 3) and severe gummy smile. Initially, the length of tooth #21 was used as a clinical parameter and was measured as 8.8 mm (Fig. 4). The gummy smile was measured as 12.7 mm in height (Fig. 5).

Systemic alterations were not reported. Gingivoplasty was suggested. However, the application of botulinum toxin was proposed to complement the result of gingivoplasty, and the patient was counseled about the recurrence of gummy smile 6 months after the application. The patient agreed to the proposed treatment and signed the terms of consent for the application of botulinum toxin and use of images.

Under local infiltrative anesthesia, gingivoplasty was performed by determination of the bleeding points with the aid of a millimeter probe and the union of these points with an electric scalpel.² The length of the teeth was increased, characterizing the gingival zenith. Posteriorly, scraping was performed, resembling the external bevel technique, with the purpose of increasing the tissue reparation (Figs. 6 & 7). There was no need for surgical cement, given that the wound repair process occurs by secondary intention. The patient was instructed on care and analgesics were administered postoperatively.

After 30 days, satisfactory tissue reparation was observed (Fig. 8) and the patient reported no changes or complaints. With use of Chu’s proportion gauge (Hu-Friedy), the improvement of the relation between
the length and width of the teeth after the gingivoplasty was observed (Fig. 9). However, the persistence of the gummy smile was observed too (Fig. 10). The length of tooth #21 had been increased from 8.8 mm to 9.7 mm (Fig. 11). The gummy smile had increased because of the higher dynamics of the upper lip, despite gingivoplasty (Fig. 12).

In the same treatment session, botulinum toxin was applied. Prior to application, the surface of the skin was disinfected with ethanol to avoid local infection and remove the skin oiliness. Posteriorly, local anesthetic (EMLA, Astra) was applied with the purpose of promoting comfort during the procedure. Botulinum toxin type A (Botox 200 units, Allergan Pharmaceuticals) was diluted in 2 ml of saline solution, according to the manufacturer’s instructions, and 2 units were injected at the recommended site, laterally to each nostril, at the level of the nose wing, at the insertion of the levator labii superioris alaeque nasi muscle. After application, the patient was advised not to lower her head or engage in physical activity during the first 4 h after the procedure. After 15 days, the patient was evaluated. She presented with uniform descent of the upper lip (Fig. 13) and reported no side effects or complaints. The clinical effect of botulinum toxin application remained for 6 months.

**Discussion**

Several etiologies of gummy smile have been suggested, such as vertical excess of the maxilla,1,4–8 delayed passive eruption,1,4,6,8 hyperfunction of the muscles involved in smiling1,6,8 and reduced length of the clinical crowns.1–3 These etiologies may occur singly or in combination and determine the type of treatment to be applied. In gummy smile caused by muscular hyperfunction, botulinum toxin is indicated. It is the treatment of choice owing to its facility and security of application, besides being a more conservative approach compared with surgical procedures (myectomy or LeFort I osteotomy).1,4,10

Smiling is performed by several facial muscles, such as the levator labii superioris, the levator labii superioris alaeque nasi, and the zygomaticus major and minor.1,4–9 The fibers of these muscles converge at the same area, forming a triangle, making it possible to include the 3 muscles in a single injection. The proposed site of the injection was lateral to the nose wing.1,4,7–9 The toxin, when injected, can spread over an area of 20 mm, allowing effective extension.1,4,5 The toxin decreases the contraction of the muscles responsible for the elevation of the upper lip, reducing gingival exposure.4–9

Botulinum toxin is a hydrophilic powder, stored under vacuum, sterile and stable.1,6,7 Reconstitution is by effortless injection of the diluent (0.9% sodium chloride) into the bottle. It has to be stored at 2–8°C and used within 4–8 h in order to guarantee its effectiveness.1,8 Clinical effects present 2–10 days after the injection, and the maximum visible effect occurs after 14 days of injection.1,4,6 This effect lasts for approximately 3–6 months.1,5,6,8 Contraindications to the use of botulinum toxin include pregnancy and lactation, neurodegenerative and autoimmune diseases, and concurrent use of an aminoglycoside antibiotic that would enhance the action of the toxin.1,8

In this report, the result was satisfactory regarding the harmony of the smile by combination of the treatments—gingivoplasty and application of botulinum toxin. Each of these treatments in isolation could not have achieved the same level of excellence. Initially, the creation of the new gingival zenith after gingivoplasty promoted the new dental architecture, favoring gingival, dental and facial harmony for the patient. Subsequently, the application of botulinum toxin reduced the gummy smile, by the uniform descent of the upper lip, smoothing the facial lines of the smile, as can be seen in the nasolabial folds, adjacent to the nostrils, by comparing Figures 1 & 13.

**Competing interests**

The authors declare that they have no competing interests.

**Figure legends**

Fig. 1 – Severe gingival exposure, indicating gummy smile.

Fig. 2 – Discrepancy between the lengths of the maxillary teeth.

Fig. 3 – Length of tooth #11 measured with Chu’s proportion gauge.
Fig. 4 – Length of tooth #21 measured with a digital pachymeter (8.8 mm).

Fig. 5 – Gummy smile measured with a digital pachymeter (12.7 mm).

Fig. 6 – Immediate postoperative photograph of teeth #21, 22 and 23.

Fig. 7 – Immediate postoperative photograph after gingivoplasty.

Fig. 8 – Thirty days after gingivoplasty.

Fig. 9 – Improvement of the relation between the length and the width of the teeth after gingivoplasty.

Fig. 10 – Persistence of the gummy smile after gingivoplasty.

Fig. 11 – Increase of the length of tooth #21.

Fig. 12 – Reduction of the gummy smile by the gingivoplasty.

Fig. 13 – Result 15 days after botulinum toxin application.

References


Prevalence of esthetic gingival recession in university health care in a region of Spain

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Abstract

Objective
The objective of the study was to evaluate, in a random population sample, the prevalence of gingival recession in the anterior zone of patients at the dental faculty of the University of Santiago de Compostela.

Materials and methods
We designed a cross-sectional epidemiological study. A random sample of 100 patients at the faculty was studied. We obtained and analyzed data regarding demographics, smoking habit, recession characteristics, dental history and esthetic importance for the patient.

Results
The prevalence of recession in the anterior zone was relatively frequent at 26%. There were statistically significant relationships between the location of the recession and smoking habit and number of teeth with recession. We also observed statistically significant results between the number of teeth with recession and sex, molar relationship, periodontal disease and periodontal biotype. In patients with more than 4 teeth with recession, most had a nonassessable molar relationship, and most had periodontal disease. It is important to note the significant relationships established between distance of the recession from the cementoenamel junction, pocket depth and loss of supporting tissue, and periodontal disease and plaque index.

Conclusion
The presence of recession in the anterior zone was relatively frequent in our setting. There are many factors related to the presence of recession, such as smoking, periodontal disease, pocket depth, loss of supporting tissue and nonassessable molar relationship.

Keywords: Gingival recession; periodontal disease; periodontal biotype; plaque index.

Introduction

The presence of gingival recession is frequent in the adult population, causing not only esthetic alterations but also sensitivity problems and/or root caries.1, 2 We define gingival recession as the apical migration of the gingival margin from the cementoenamel junction, resulting in root exposure. Although in adults the presence of gingival recession is frequent, the prevalence, extent and severity present differences between the various populations studied, age, sex, oral hygiene level and brushing technique being among the main contributing factors.3
Upon analyzing the prevalence rates in various studies, we observed disparate results. In a study conducted in the U.S. with 9,689 subjects, the prevalence of gingival recession was 58% for individuals between 30 and 90 years of age, yielding an average of 22.3% of affected teeth per person.\(^1\) Geiger found that between 78% and 100% of middle-aged individuals have recession, present around between 22% and 53% of the teeth.\(^4\) In a longitudinal study conducted in Barcelona, gingival recession was observed in 85% of the individuals in the sample, a prevalence that did not change in a follow-up test performed 10 years later; however, the average number of teeth with recession per person varied (a total of 210 in the initial examination and 299 in the second examination), and the average height of the recession increased, while the control variable, plaque, decreased.\(^5\)

Regarding etiology, we know that this condition is determined by both susceptibility factors and anatomical factors, such as fenestration and dehiscence of the alveolar bone or an abnormal position of the tooth in the arch. These factors can result in thinner alveolar bone than usual, which can be more susceptible to resorption.\(^2\) Gingival recession is also conditioned by causal factors, such as physiological and pathological factors; physiological factors, such as orthodontic movements of the teeth out of the buccal and lingual cortical bone;\(^2,6\) and pathological factors, such as incorrect brushing technique and the types of brush and bristles, intraoral and perioral piercings, occlusal trauma or poor oral hygiene that leads to the accumulation of bacterial plaque.\(^2,6–11\) Since the presence of gingival recession is commonly observed in the daily practice at a dental clinic, we considered it important to study its prevalence owing to the esthetic and health consequences. Therefore, we analyzed the relationship between different variables (such as smoking habit, periodontal biotype and molar relationship) and the presence of recession and its characteristics (such as distance of the recession from the cementoenamel junction and number of teeth with recession).

The main objective of this study was to evaluate, in a random population sample, the prevalence of gingival recession in the anterior zone, whether or not the recession was symptomatic. The study’s secondary objective was to study the factors associated with this recession.

**Materials and methods**

We designed a cross-sectional epidemiological study of the prevalence of gingival recession in the anterior zone of patients at the dental faculty of the University of Santiago de Compostela (USC). This study was approved by the USC ethics committee (reference no. TFG 2016/23).

The data were obtained by collecting specific standardized variables for this study, which were always measured by 2 specific operators. The operators had previously performed a calibration for the correct evaluation of the variables. In cases of discrepancy, a third operator corroborated the results. These variables were grouped as follows:

- demographics (age, sex, level of education and other demographic information);
- smoking habit (those who had stopped up to 5 years before the study were considered smokers);
- lesion characteristics (location of the recession, distance of recession from the cementoenamel junction, pocket depth, supporting tissue loss, root caries and other characteristics);
- dental history (molar and canine relationship, presence or absence of periodontal disease, periodontal biotype and other factors); and
- esthetic importance for the patient.

Next, periodontal disease was evaluated as follows:

1. Regarding periodontal disease, we differentiated between whether periodontal disease was or was not present; in cases where it was present, we determined the degree of severity (mild, moderate or severe). The disease was considered mild when there was between 1 and 2 mm of supporting tissue loss, moderate when there was between 3 and 4 mm of supporting tissue loss, and severe when there was greater than 5 mm of supporting tissue loss.\(^12\) Regarding the plaque index, there was also differentiation between whether or not plaque was present. In such cases, plaque could be mild or abundant: Plaque was considered mild when it covered less than one-third of the clinical crown and abundant when it was equal to or greater than one-third of the crown.\(^13\)

2. To classify the patient’s periodontal biotype, we distinguished between thin and thick.\(^14\) In the thin biotype, the gingival margin was thin and scalloped,
Table 1: Descriptive data of qualitative variables of the study.

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Table 1: Descriptive data of qualitative variables of the study.

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## Table 1: Descriptive data of qualitative variables of the study.

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### Table 1: Descriptive data of qualitative variables of the study.

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<td><strong>Periodontal biotype</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thin</td>
<td>12</td>
<td>46.2</td>
</tr>
<tr>
<td>Thick</td>
<td>14</td>
<td>53.8</td>
</tr>
</tbody>
</table>

### Table 2: Descriptive data of quantitative variables of the study.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recession distance (mm)</td>
<td>3.00</td>
<td>1.07</td>
<td>1.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Pocket depth (mm)</td>
<td>2.95</td>
<td>1.32</td>
<td>1.00</td>
<td>6.83</td>
</tr>
<tr>
<td>Supporting tissue loss (mm)</td>
<td>5.95</td>
<td>2.15</td>
<td>2.00</td>
<td>11.83</td>
</tr>
</tbody>
</table>
## Table 3: Levels of significance for the variable “location of recession in maxilla”.

<table>
<thead>
<tr>
<th>Principal variable</th>
<th>Secondary variable</th>
<th>Chi-square test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of recession in maxilla</td>
<td>Sex</td>
<td>0.408</td>
</tr>
<tr>
<td></td>
<td>Level of education</td>
<td>0.747</td>
</tr>
<tr>
<td></td>
<td>Smoking habit</td>
<td><strong>0.037</strong></td>
</tr>
<tr>
<td></td>
<td>Cigarettes/day</td>
<td>0.285</td>
</tr>
<tr>
<td></td>
<td>No. of missing teeth</td>
<td>0.388</td>
</tr>
<tr>
<td></td>
<td>Left molar relationship</td>
<td>0.416</td>
</tr>
<tr>
<td></td>
<td>Right molar relationship</td>
<td>0.811</td>
</tr>
<tr>
<td></td>
<td>Left canine relationship</td>
<td>0.264</td>
</tr>
<tr>
<td></td>
<td>Right canine relationship</td>
<td>0.297</td>
</tr>
<tr>
<td></td>
<td>Periodontal disease</td>
<td>0.696</td>
</tr>
<tr>
<td></td>
<td>Plaque index</td>
<td>0.520</td>
</tr>
<tr>
<td></td>
<td>Bleeding on probing</td>
<td>0.913</td>
</tr>
<tr>
<td></td>
<td>Suppuration</td>
<td>0.651</td>
</tr>
<tr>
<td></td>
<td>Miller’s class</td>
<td>0.492</td>
</tr>
<tr>
<td></td>
<td>Mobility</td>
<td>0.492</td>
</tr>
<tr>
<td></td>
<td>Esthetic importance for patient</td>
<td>0.116</td>
</tr>
<tr>
<td></td>
<td>Root caries</td>
<td>0.295</td>
</tr>
<tr>
<td></td>
<td>Tooth position</td>
<td>0.178</td>
</tr>
<tr>
<td></td>
<td>Cause of recession</td>
<td>0.454</td>
</tr>
<tr>
<td></td>
<td>Periodontal biotype</td>
<td>0.091</td>
</tr>
<tr>
<td></td>
<td>No. of teeth with recession</td>
<td><strong>0.029</strong></td>
</tr>
<tr>
<td>Principal variable</td>
<td>Secondary variable</td>
<td>Chi-square test</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>No. of teeth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with recession</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td>0.027</td>
</tr>
<tr>
<td>Level of education</td>
<td></td>
<td>0.890</td>
</tr>
<tr>
<td>Smoking habit</td>
<td></td>
<td>0.344</td>
</tr>
<tr>
<td>Cigarettes/day</td>
<td></td>
<td>0.845</td>
</tr>
<tr>
<td>No. of missing teeth</td>
<td></td>
<td>0.731</td>
</tr>
<tr>
<td>Left molar relation</td>
<td></td>
<td>0.012</td>
</tr>
<tr>
<td>Right molar relation</td>
<td></td>
<td>0.023</td>
</tr>
<tr>
<td>Left canine relation</td>
<td></td>
<td>0.887</td>
</tr>
<tr>
<td>Right canine relation</td>
<td></td>
<td>0.734</td>
</tr>
<tr>
<td>Periodontal disease</td>
<td></td>
<td>0.031</td>
</tr>
<tr>
<td>Plaque index</td>
<td></td>
<td>0.061</td>
</tr>
<tr>
<td>Bleeding on probing</td>
<td></td>
<td>0.460</td>
</tr>
<tr>
<td>Suppuration</td>
<td></td>
<td>0.712</td>
</tr>
<tr>
<td>Miller’s class</td>
<td></td>
<td>0.125</td>
</tr>
<tr>
<td>Mobility</td>
<td></td>
<td>0.059</td>
</tr>
<tr>
<td>Esthetic importance for patient</td>
<td></td>
<td>0.504</td>
</tr>
<tr>
<td>Root caries</td>
<td></td>
<td>0.059</td>
</tr>
<tr>
<td>Tooth position</td>
<td></td>
<td>0.250</td>
</tr>
<tr>
<td>Cause of recession</td>
<td></td>
<td>0.212</td>
</tr>
<tr>
<td>Periodontal biotype</td>
<td></td>
<td>0.009</td>
</tr>
<tr>
<td>Location of recession in maxilla</td>
<td></td>
<td>0.029</td>
</tr>
</tbody>
</table>

Table 4: Levels of significance for the variable “number of teeth with recession”.
## Gingival recession in Spanish population

<table>
<thead>
<tr>
<th></th>
<th>Recession distance</th>
<th>Pocket depth</th>
<th>Supporting tissue loss</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>0.097</td>
<td>0.018</td>
<td>0.027</td>
<td>0.683</td>
</tr>
<tr>
<td>Level of education</td>
<td>0.421</td>
<td>0.473</td>
<td>0.233</td>
<td>0.637</td>
</tr>
<tr>
<td>Smoking habit</td>
<td>0.131</td>
<td>0.076</td>
<td>0.067</td>
<td>0.274</td>
</tr>
<tr>
<td>Cigarettes/day</td>
<td>0.514</td>
<td>0.050</td>
<td>0.165</td>
<td>0.490</td>
</tr>
<tr>
<td>No. of missing teeth</td>
<td>0.434</td>
<td>0.593</td>
<td>0.546</td>
<td>0.302</td>
</tr>
<tr>
<td>Left molar relationship</td>
<td>0.620</td>
<td>0.136</td>
<td>0.322</td>
<td>0.626</td>
</tr>
<tr>
<td>Right molar relationship</td>
<td>0.697</td>
<td>0.338</td>
<td>0.452</td>
<td>0.108</td>
</tr>
<tr>
<td>Left canine relationship</td>
<td>0.556</td>
<td>0.383</td>
<td>0.321</td>
<td>0.271</td>
</tr>
<tr>
<td>Right canine relationship</td>
<td>0.433</td>
<td>0.067</td>
<td>0.137</td>
<td>0.069</td>
</tr>
<tr>
<td>Periodontal disease</td>
<td>0.007</td>
<td>0.031</td>
<td>0.005</td>
<td>0.173</td>
</tr>
<tr>
<td>Plaque index</td>
<td>0.006</td>
<td>0.004</td>
<td>0.001</td>
<td>0.233</td>
</tr>
<tr>
<td>Bleeding on probing</td>
<td>0.287</td>
<td>0.026</td>
<td>0.050</td>
<td>0.050</td>
</tr>
<tr>
<td>Suppuration</td>
<td>0.069</td>
<td>0.001</td>
<td>0.004</td>
<td>0.069</td>
</tr>
<tr>
<td>Miller’s class</td>
<td>0.005</td>
<td>0.003</td>
<td>0.000</td>
<td>0.200</td>
</tr>
<tr>
<td>Mobility</td>
<td>0.007</td>
<td>0.002</td>
<td>0.000</td>
<td>0.176</td>
</tr>
<tr>
<td>Esthetic importance for patient</td>
<td>0.200</td>
<td>0.339</td>
<td>0.107</td>
<td>0.367</td>
</tr>
<tr>
<td>Root caries</td>
<td>0.095</td>
<td>0.019</td>
<td>0.019</td>
<td>0.219</td>
</tr>
<tr>
<td>No. of teeth with recession</td>
<td>0.131</td>
<td>0.435</td>
<td>0.179</td>
<td>0.133</td>
</tr>
<tr>
<td>Location of recession in maxilla</td>
<td>0.555</td>
<td>0.733</td>
<td>0.734</td>
<td>0.084</td>
</tr>
</tbody>
</table>

**Table 5**: Levels of significance for the quantitative variables “recession distance,” “pocket depth,” “supporting tissue loss” and “age.”
the papillae were high, the coronal morphology was long and conical, with a point of fine contact, the root morphology was convex, and the bony crest was very thin and scalloped. In the thick biotype, the gingival margin was thick and only slightly scalloped, the papillae were low, the coronal morphology was short and square, with a wide contact point, the root morphology was concave, and the bony crest was thick.

3. For the variable “cause of the recession,” we studied different causes, such as brushing technique,5,15 periodontal disease, bruxism, orthodontic treatment16 and piercing, as well as mixed causes and other causes. In this last category, we included anomalous tooth positions, other direct traumatic factors and all cases in which recession was not related to any of the causes already mentioned. We considered the cause of recession to be mixed when the recession was due to 2 or more causes. For the collection of these data, we used an exploration kit consisting of a mirror, an exploration probe and a CP12 periodontal probe.

Sample size
The study was conducted during a period of 8 months between September 2016 and April 2017. For calculation of the sample size, the proportion of patients exposed to the etiological factors and who had gingival recession according to the literature was taken into account, that is, 35%. Therefore, we would have to obtain an odds ratio of 0.290; for a statistical power of 80%, we would need a sample of 86 patients. A random sample of 100 patients was analyzed from patients at the USC dental faculty, of which 26 had gingival recession, symptomatic or nonsymptomatic in the anterior zone. In these 26 patients, an additional evaluation of the recession characteristics was performed. To participate in this study, the patients’ consent was obtained to proceed with the data collection.

Statistical analysis
All data were coded and analyzed using the SPSS program (Version 20.0, IBM Corp.). Descriptive statistics were calculated using the frequencies and percentages for the categorical variables and the means and the standard deviations for the quantitative variables. Contingency tables were constructed using the chi-square test. Statistical analysis was performed by comparing means in nonparametric analysis using the Mann–Whitney test and 1-way analysis of variance. All the differences in which the value of P was less than or equal to 0.05 were considered statistically significant.

Results
The descriptive results of the study are summarized in Tables 1 and 2. The prevalence of recession in the anterior zone in patients at the USC dental faculty was 26% (n = 100). The average age of the patients in this study was 53.35 years. Of the total patients with gingival recession in the anterior zone, 57.7% were women.

Regarding smoking habit, 14 of the 26 patients who had recession in the anterior zone were nonsmokers. When we considered the molar relationship presented by the patients, both the left and right molar relationships were generally not assessable: 53.8% (left molar relationship) and 73.1% (right molar relationship). Among the 26 patients, 46.2% had more than 4 teeth with recession. Approximately 65% of the patients had periodontal disease, and almost 77% had plaque. However, the vast majority did not have suppuration of the teeth with recession (22 of 26 patients). All instances of recession in our study were classified as Miller class I or II. A total of 76.9% of the teeth with recession did not present with either mobility or root caries. Most teeth with recession had normal positioning in the arch (69.2%), and 65.4% of the patients did not regard the recession as esthetically important. The main cause of recession, in up to 30% of cases, was periodontal disease, and 53.8% of the patients had a thick periodontal biotype. We established 6 main variables: location of the recession in the maxilla, number of teeth with recession, age, distance of the recession from the cementoenamel junction (in millimeters), pocket depth and supporting tissue loss (Tables 3–5). There were statistically significant relationships between location of the recession in the maxilla and smoking habit and number of teeth with recession (chi-square test, P = 0.037). When recession were present in both arches, most patients were smokers and most had more than 4 teeth with recession. We also observed statistically significant associations between the number of teeth with recession and sex (chi-square test, P = 0.027), molar relationship (chi-square test, P = 0.012 and P = 0.023), periodontal disease presence (chi-square test, P = 0.031) and periodontal biotype (chi-square test, P = 0.009). In patients with more than 4 teeth with
recession, 53.84% had a nonassessable molar relationship and 65.38% had periodontal disease; 50% of them had severe periodontal disease.

We observed that patients with 2 teeth with recession had a thick periodontal biotype, whereas among individuals with more than 4 teeth with recession, 83.7% had a thin periodontal biotype.

Regarding the other main variables, it is worth mentioning the statistically significant relationships established between distance of the recession from the cementoenamel junction, pocket depth and loss of supporting tissue, and periodontal disease and plaque index. The greater the severity of the periodontal disease and the higher the plaque index, the greater the measurements of recession distance, pocket depth and loss of supporting tissue. Statistically significant relationships were also observed between these 3 main variables and Miller’s class and the presence or absence of mobility. In the case of a Miller class II recession with or without mobility, the average recession distance, pocket depth and supporting tissue loss were significantly higher.

Discussion

In this study, which used a sample of 100 patients with an average age of 53.35 years, we obtained a prevalence of recession in the anterior zone of 26%. Comparison with other studies is difficult because most of them did not limit the study only to the presence of recession in the anterior zone. Even so, when comparing the prevalence rates with other research, taking the 26% into account, we noted that our prevalence rate was relatively lower.\(^1,5,17\)

In our study, recession was more frequent in women (57%) than in men. However, among patients with more than 4 teeth with recession, more than half were men. In our study, the number of missing teeth in relation to the presence of recession did not present a statistical relationship, as in other studies reviewed.\(^15\) However, we did find a strong association between molar relationship and the number of teeth with recession. A large portion of the patients with more than 4 teeth with recession had a nonassessable molar relationship. This finding makes us think that the absence of the molars is likely to cause an excess of force on the anterior teeth and, as a consequence, the appearance of recession around more of those teeth.

Regarding smoking habit and its established relationship with the location of the recession in the maxilla, when patients had recession in both arches, more than 70% were smokers or had been until less than 5 years before. The same did not occur in patients who only had recession in 1 arch; more than 80% were nonsmokers. We have found studies in which the same relationship was established, including two that suggest the possible local effect of cigarettes.\(^6,19\)

In our study, we noted that all instances of recession were classified into Miller class I or II, a finding that coincides with that of another study, in which most of the teeth observed were also classified as Miller class I or II.\(^19\) Most studies argue that a thin periodontal biotype is a predisposing factor for recession.\(^5,20\) However, in this present study, more than half of the patients had a thick periodontal biotype and still had recession. However, the majority of patients with more than 4 teeth with recession had a thin periodontal biotype. The number of teeth with recession, the recession distance, the pocket depth and the supporting tissue loss presented strong associations with the presence of periodontal disease.

The exposure of the root to the oral cavity either directly by recession or by the presence of a periodontal pocket was directly related to an increased risk of root caries.\(^21\) At the same time, our research revealed a relationship between the loss of supporting tissue and pocket depth. Based on the results obtained, the previous literature supports some of the established relationships, such as between the location of the recession in the maxilla and smoking or the relationships between supporting tissue loss, periodontal disease and plaque index. However, we also made findings in opposition to those of previous studies, as in the case of the relationship between the presence of recession and the periodontal biotype. One of the limitations of this study is the limited number of published studies to which to compare some of the relationships established between variables in our work.
Conclusion

The prevalence of recession in the anterior zone was relatively frequent in our setting, at 26% in this study. Comparison with other studies was difficult because others were not limited only to the anterior zone. There are many factors related to the presence of recession, such as smoking, periodontal disease, pocket depth, loss of supporting tissue and nonassessable molar relationship. It is necessary to identify these factors incipiently to prevent recession and associated complications. To make more powerful inferences, it would be necessary to conduct studies in broader subpopulations.

Competing interests

The authors declare that they have no competing interests.

Legends

Table 1 – Descriptive data of qualitative variables of the study.

Table 2 – Descriptive data of quantitative variables of the study.

Table 3 – Levels of significance for the variable "location of recession in maxilla".

Table 4 – Levels of significance for the variable "number of teeth with recession".

Table 5 – Levels of significance for the quantitative variables "recession distance," "pocket depth," "supporting tissue loss" and "age".

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20. Palkovics D, Gera I. [The significance of biotype in the predictability of dental-periodontal treatment].
Hungarian.
→ Fogorv Sz.

21. Tugnait A, Clerrehugh V. Gingival recession—its significance and management.
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Topical doxycycline after nonsurgical instrumentation of deep periodontal pockets: Results from a prospective case series with 12 months’ follow-up

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Abstract

Objective
The objective of this paper was to evaluate the clinical results at 12 months of a topical application of doxycycline after nonsurgical instrumentation of deep periodontal pockets.

Materials and methods
Forty healthy patients previously treated for periodontal disease, with 1 or more residual periodontal pockets of at least 6 mm in depth around nonmolar teeth, were enrolled. After registration of pocket depth (PD), clinical attachment loss (CAL) and bleeding on probing (BOP), the pockets were nonsurgically treated with hand and ultrasonic instruments, then a single topical application of 14% doxycycline hyclate gel was performed. At 12 months, measurement of PD, CAL and BOP was repeated. The results underwent statistical analysis by means of the Student t test for paired data (PD and CAL) and the chi-square test (BOP).

Results
Of the 40 enrolled patients, 35 (14 males and 21 females; mean age: 59.94 years) attended the 12-month clinical reevaluation. The analysis was therefore based on the data from 87 pockets. The initial values were: PD = 7.28 ± 1.69 mm, CAL = 9.00 ± 2.40 mm and BOP = 78.16%. The 12-month values were: PD = 4.62 ± 1.77 mm, CAL = 6.75 ± 2.54 mm and BOP = 22.99%. The difference was of high statistical significance (P < 0.001) for all clinical parameters.

Conclusion
Nonsurgical treatment by means of hand and ultrasonic instruments plus a single topical doxycycline application showed high efficacy in deep periodontal pockets (≥ 6 mm).

Keywords: Periodontal disease; nonsurgical periodontal therapy; periodontal pocket; topical doxycycline.

Introduction
The first goal of periodontal therapy is to remove the biofilm on supragingival and subgingival dental surfaces. This decontamination, which is the result of correct at-home plaque control and of sound professional instrumentation of root surfaces, is able to eliminate the bacterial infection which is the cause of periodontitis, reducing inflammation and pocket probing depth.
and allowing regaining of the clinical attachment of affected and treated teeth.\textsuperscript{1} Nonsurgical debridement is not always able to achieve the ideal results just mentioned, especially when deep pockets require treatment.\textsuperscript{2} When nonsurgical therapy is not appropriate, surgical procedures are indicated.\textsuperscript{3}

In serious cases of generalized aggressive periodontitis, the association of systemic antibiotics has proved to be very effective after nonsurgical pocket instrumentation.\textsuperscript{4,6} In order to improve the results of nonsurgical therapy, the topical application of antibiotics in addition to conventional instrumentation has also been proposed,\textsuperscript{7-13} in particular for the treatment of isolated sites with severe periodontitis, as can often be found during maintenance therapy\textsuperscript{11} in subjects also previously successfully treated.

Specifically, slow-release 14\% doxycycline hyclate gel was able to release therapeutically effective doses for more than 10 days even after a single local administration.\textsuperscript{11} The aim of this study was to evaluate the clinical outcome of nonsurgical periodontal instrumentation associated with a single topical application of doxycycline in deep pockets.

Materials and methods

This prospective case series was conducted according to the guidelines of the STROBE statement for observational studies.\textsuperscript{14} All procedures followed in this study were in accordance with the ethical standards of the Declaration of Helsinki of 1975 as revised in 2013.

From the same private practice for the treatment of periodontal disease, 40 patients (18 males and 22 females) were selected from Jan. 2 to Feb. 28, 2017, using the following inclusion criteria: age between 35 and 75 years, absence of systemic diseases, previously diagnosed and treated periodontal disease (through oral hygiene motivation and instruction, professional nonsurgical periodontal debridement and, eventually, surgical therapy), nonsmoker or smoking less than 10 cigarettes/day, plaque index of lower than 25\%, enrollment in a regular periodontal maintenance therapy program, and 1 or more residual periodontal pockets of at least 6 mm around nonmolar teeth, which were the subject of this study. In the sites to be treated, the clinical parameters of pocket depth (PD), clinical attachment loss (CAL) and bleeding on probing (BOP) were registered by calibrated clinicians (2 dentists and 2 dental hygienists; Fig. 1).
After local anesthesia with articaine plus 1:100,000 epinephrine, the selected pockets underwent a single nonsurgical periodontal debridement using hand (curettes) and ultrasonic (XO Odontogain, XO CARE) instruments. For each tooth, every root aspect (mesial, distal, buccal and lingual) included in the study was instrumented for 3–5 min, according to the operator’s assessment during the instrumentation and a single topical application of a 14% doxycycline hyclate gel (Ligosan, Heraeus Kulzer) was then performed (Fig. 2).

In the postoperative period, the patients were to avoid at-home oral hygiene for 1 day, replacing it with chlorhexidine spray applications (Corsodyl Spray, GlaxoSmithKline) after meals, and to avoid chewing at the sites being treated. The patients followed a regular personalized program of professional oral hygiene sessions every 3 or 4 months, but no subgingival instrumentation of the treated sites was performed during such recalls. Twelve months after treatment, the previously recorded clinical parameters (PD, CAL and BOP) were reregistered (Fig. 3).

The results underwent statistical analysis by means of the Student t test for paired data (PD and CAL) and the chi-square test (BOP). P values of < 0.005 were considered statistically significant.
Results

Of the 40 patients enrolled in the study, 35 (14 males and 21 females; mean age: 59.94 ± 9.34 years) attended the 12-month clinical reevaluation. The 5 dropouts were due to missing a periodontal recall scheduled for maintenance therapy (3 patients), to a periapical lesion needing endodontic therapy of the tooth involved in the study (1 patient) and to moving abroad (1 patient). The analysis was therefore based on data from 87 pockets. The mean initial and final values are reported in Table 1. A mean PD reduction of 2.66 ± 1.52 mm, a mean CAL gain of 2.25 ± 1.45 mm and a mean BOP reduction of 55.16% were recorded. The difference was of high statistical significance (P < 0.001) for all clinical parameters.

Discussion

The results of the study showed a significant improvement in all periodontal parameters (PD, CAL and BOP) after nonsurgical treatment and a single topical doxycycline application in deep pockets of ≥ 6 mm around nonmolar teeth, confirming what has already been reported in literature for clinical parameters. Also in this case, it is emphasized that the long time dedicated to root debridement, with manual and ultrasonic instruments, may have contributed to the good results, as well as in previous works, compared with those reported for studies in which less time was devoted to this important step of the therapy.

Very interesting in the results was the minimum amount of postoperative recession (PD reduction—CAL gain) reported in the present study. The same treatment modality investigated in this study had already been described to provide a high possibility of reducing pocket depth from ≥ 6 mm to ≤ 5 mm than subgingival instrumentation alone, without the application of topical doxycycline.

The data presented in this study can therefore orient toward a possible association between nonsurgical periodontal therapy and a single topical application of doxycycline as an alternative to surgical procedures, thus providing a valid therapeutic option in all those situations in which clinicians and patients prefer or have to limit the invasiveness of the treatment. Caution is recommended in the use of antibiotics owing to possible development of resistance to antimicrobial agents; however, in a previous study, application of 14% doxycycline gel demonstrated high efficacy toward periodontal pathogens without any induced resistance. The stability of the results after the treatment needs to be evaluated in studies with longer follow-up and with a control group.

Conclusion

In patients that follow a regular periodontal maintenance therapy program, nonsurgical treatment by means of hand and ultrasonic debridement plus a single topical doxycycline application showed high efficacy in deep periodontal pockets (≤ 6 mm) around nonmolar teeth.

Competing interests

The authors declare that they have no competing interests.

Acknowledgments

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Legends

Fig. 1 – Recording of the initial values of pocket depth, clinical attachment loss and bleeding on probing.
Fig. 2 – Single application of locally delivered controlled-release 14% doxycycline gel after nonsurgical instrumentation.

Fig. 3 – Recording of the values of pocket depth, clinical attachment loss and bleeding on probing at the 12-month reevaluation.

References


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