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EDITORIAL

Success or survival

Horia Mihail Barbu[1]
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The dental patient with his pathology, his needs and his demands represents the point of departure for the research and innovations in dentistry. He is the most important recipient of the clinical advancement and innovations achieved through medical science. This journal is meant to provide the scientific content and peer-reviewed research to improve clinical outcome, as well as treatment planning options, in order to enhance success of dental treatment [1].

Among the dental branches, oral implantology has evolved as vital part in oral rehabilitation of partially and completely edentulous patients [2]. The dental implant is considered a primary option to replace a single tooth or multiple adjacent missing teeth, or to support a fixed or removable prosthesis [2]. Case series described in various articles serve as a basic guide for the dental practitioner. Information on medical history, bone and pharmacology led to complex treatment planning and surgical procedures, providing the reader with a virtual clinical situation, its complications and resolutions.

A challenging topic in implant dentistry is represented by implant insertion following tooth extraction. The subject is far more interesting in patients with chronic periodontal disease, for whom full–mouth extraction and immediate implant placement is planned. The benefits and the disadvantages of this technique are placed in high contrast when analysing the meaning of successful medical therapy. Immediate success and satisfaction of the patient, by shortening the duration of his treatment plan and reducing the number of the surgical stages, confronts the great endangering of long term implant survival.

Extraction of all natural teeth results in bacteriological modifications, with reduction of common microorganism responsible for periodontal disease [3]. Thus, the presence of bacteria, even in lower concentration, associated with poor, local immune defence contribute to further bone loss of implants inserted in post-extraction sockets. According to cohort studies, patients with history of treated periodontitis have a higher risk to experience peri-implantitis compared with periodontally healthy subjects [3]. One-stage procedures, with post-extraction implant insertion in patients with periodontal disease, ensure 3- to 5- year implant survival [4]. For periodontally compromised patients, implant placement remains a viable treatment option, with long–term success by staged-approach procedures.

One requirement before implant placement is the complete treatment of the periodontal disease. In addition, periodontal indexes should be monitored over time and we should proceed with implant treatment only with reduced inflammatory indexes, in order to reduce the risk of complications and implant failure [5].

Post-extraction implant placement with immediate temporary restoration may represent a fast and short path in providing the aesthetics and masticatory function for the periodontally compromised patients. Although, by its definition, oral rehabilitation combines the advantages of this technique, the results in the years to follow contradict the same principle. It's a professional duty of the practitioner to guide the treatment options for the patient's long-term benefit. The treatment plan for the patients with advanced

periodontitis must consider a detailed analyse of the immediate impact and prognosis of the oral disorder on the osseointegration process. Success in terms of oral rehabilitation frequently requires several, varied procedures in the management of the patient's treatment plan.

Arguments for certain techniques are often demonstrated by studies and highlighted through scientific writing. We encourage the authors to develop as many topics as possible, to exemplify new techniques and to publish the results of their researches in this journal, in order to provide quality of the medical performance.

Conflict of interest: None to declare.

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ORIGINAL PAPER

The use of triple antibiotic paste and blood clot for revascularization and regeneration of the pulp in endodontics.

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Abstract

Objective: The main reason of the present study is to analyse the methods and protocols that have been discovered and used until now in endodontic therapy for a necrotic tooth with or without immature root.

Methods: An electronic search was done in ResearchGate and PubMed using terms about revascularization and regeneration in endodontics between 2004 and 2018. Every clinical trial was read and selected based on the most interesting cases no regardless of the results.

Results: Thirty publications are noted in this research that used triple antibiotic paste consisting of metronidazole, ciprofloxacin, and minocycline as an intracanal medicament. All canals were irrigated with sodium hypochlorite 2.25% or higher and in no case were they mechanically instrumented. In 93% of the relevant studies, mineral trioxide aggregate was used as an intracanal coronal barrier.

Conclusions: Modern endodontic therapy on immature teeth with immature apex and necrotic pulp has achieved excellent results using antibiotic paste and blood clotting without any mechanical instrumentation.

Keywords: regenerative endodontics, triple antibiotic paste, irrigation system, non-invasive treatment, blood clot.

Introduction

The ultimate goal of endodontic treatment is to save the tooth from extraction and long-term arcade maintenance of the tooth whose pulp is irreversibly compromised [1]. The pulp, the living tissue inside the tooth, is protected against the harmful factors in the external environment by the harsh tissues that surround it outside [1, 2]. Various aggressions, the most common carious processes but also traumas and dental treatments, lead to the destruction and reduction of the quantity of harsh tissues. If irritation factors whether physical, chemical or biological act brutally, physiological pulp defences will be overwhelmed, resulting in irreversible inflammation or necrosis of the pulp tissue [2, 3]. When pulp necrosis occurs, the pulpal blood supply is non-existent, and the pulpal nerves are not functional. This dead space, privately vascularized and safe from the immune system, offers the right conditions for life and represents the ideal shelter for bacteria [4].

Compared to a normal pulp which is symptom-free and responds normally to the pulp tests, pulp necrosis is usually nonresponsive to the pulp testing. The tooth remains in this condition until such time when the bacteria affects the periradicular tissues and become symptomatic to percussion. Losing an immature permanent tooth can lead to malocclusion and loss of function. An incompletely formed root in need of endodontic treatment is a real challenge for the clinicians, having an immature apex that cannot be cleaned and shaped properly [5]. The most common procedure in those cases is apexification which has the potential disadvantage to reduce root strength [6].

Nowadays, non-surgical root canals have become a routine procedure. That being said, regenerative endodontic procedures are aiming to replace the damaged structures keeping the normal function of the pulp-dentin complex with the continuing development of the root [8]. The effectiveness of combination of ciprofloxacin, metronidazole, and minocycline has been demonstrated, as seen in the publications listed below [Table 1], in the destruction of the bacteria from the root canals. Compared to the apexification using calcium hydroxide, the triple antibiotic paste does not reduce the root strength. It would be expected that the lack of mechanical

instrumentation would result in the persistence of the bacteria in the canal roots but the irrigation with sodium hypochlorite whether in combination with other solutions such as chlorhexidine or ethylenediaminetetraacetic or without aims to disinfect the canal space [7, 8, 9].

That being said, the purpose of the present review is to evaluate the results obtained in endodontic regeneration treatments of the last period and to identify variations in clinical procedures.

Materials and methods

An electronic search was executed in Research Gate and PubMed database between January 2004 and October 2018. The publications have been selected according to the search terms: dental pulp, revascularization, regenerative, revitalization, endodontic, endodontic therapy, triple antibiotic paste. The search was conducted for human clinical studies or case reports in vitro or ex vivo. All articles containing one or more of the above-listed terms have been evaluated and selected if they met the requirements of this study. All publications using, sodium hypochlorite, blood clot, mineral aggregate trioxide, a triple antibiotic paste consisting of metronidazole, ciprofloxacin and minocycline but not using mechanical treatment were included.

Results

Out of four hundred seventy-two articles found on the electronic search, four hundred forty-seven were removed, and thirty were finally included in this review. All of the selected studies involved human participants.

As first irrigation, sodium hypochlorite in concentration smaller than 5% was used in 36.7 % of the clinical studies. Sodium hypochlorite in concentration bigger than 5% was used in 60% while in 3.3% of the clinical studies no sodium hypochlorite was used. In 30% of the clinical studies, chlorhexidine was used as primary irrigation among the use of sodium hypochlorite. As final irrigation, sodium hypochlorite was used in 66.6%; chlorhexidine was used in 3.3%, sterile saline in 53.3% and ethylenediaminetetraacetic in 13.3%. [Table 1] [Chart 1]

In 93.3% of the clinical studies, mineral trioxide aggregate was used as an intracanal coronal barrier. The blood clot was created in 83.3% of the cases, while the rest of the authors used platelet-rich fibrin or platelet-rich plasma. [Table 1] [Chart 1]

In the end, 66% out of thirty clinical cases have resulted in an asymptomatic tooth with or without root formation while 27% declared positive responses to the cold and electric pulp tests and 7% resulted in pain or new periapical lesion. [Table 1] [Chart 1]

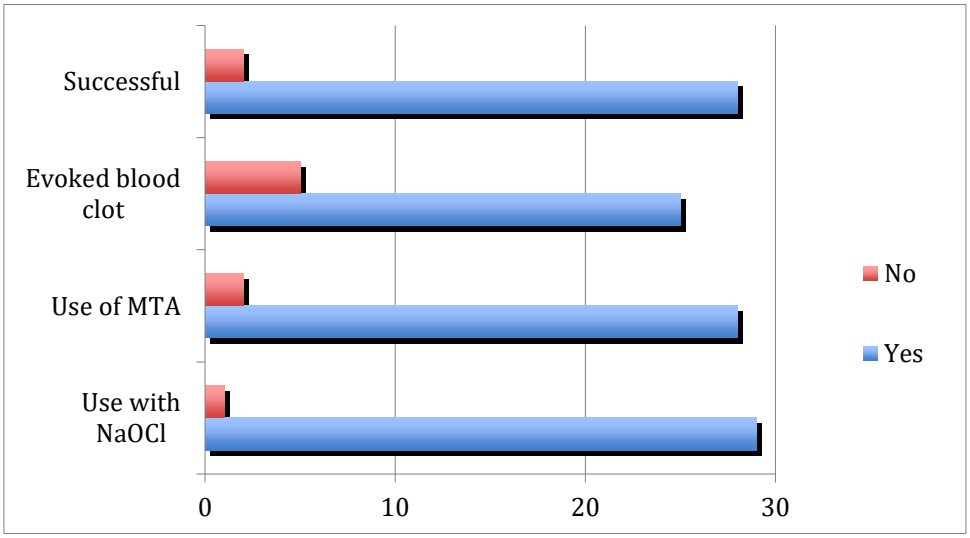

Chart 1. Summary of Succes, Agents, Methods, and Medicaments used in the clinical cases

Table 1. Presentation of the Clinical Cases and the Protocols used for Regenerative Endodontic Procedures

Study	Dental History	Initial Irrigation	Duration of medicament	Final irrigation	Evoked blood clot	Latest follow-up	Results	Intracanal coronal barrier
Banchs & Trope, 2004 [1]	Pulp necrosis Immature Apex	5.25% NaOCl + 0.12% CHX	26 days	5.25% NaOCl	Yes	2 years	Asymptomatic Closed Apex	MTA
Ding et al, 2009 [2]	Acute or chronic apical periodontits Immature apex	5.25% NaOCl	7 days	5.25% NaOCl	Yes	1 year	Complete revasculari-zation + pulp sensibility	MTA
Jung et al, 2008 [3]	Open Apex Large radiolucency	2.5% NaOCl	7 days	2.5% NaOCl	Yes	2 years	Aymptomatic Closed Apex	MTA
Reynolds et al, 2009 [4]	Pulp Necrosis Immature Apex	6% NaOCl + 2.0% CHX	30	6% NaOCl	Yes	18 months	Bone healing Root development	MTA
Kim et al, 2010 [5]	Pulp necrosis	3% NaOCl	42	3% NaOCl	Yes	8 months	Apical closure	MTA
Petrino et al, 2010 [6]	Pulp necrosis Chronic apical abcess	5.25% NaOCl + 0.12% CHX	21	5.25% NaOCl	Yes	1 year	Thickness of apical area	MTA
Jung et al, 2011 [7]	Pulp necrosis Symptomatic apical periodontitis Open Apex	2.5% NaOCl	14	2.5% NaOCl+ sterile saline	Yes	31 months	Asymptomatic	MTA
Torabine jad & Turman, 2011 [8]	Pulp necrosis Symptomatic apical periodontitis Open Apex	5.25% NaOCl	22 days	Sterile saline	No	5 months	Positive response cold and EPT test Apical closure	MTA
Jeeruph an et al, 2012 [9]	Pain Percussion sensitivity	2.5% NaOCl	29 days	2.5% NaOCl	Yes	24 months	Revascularize-tion	MTA

Nosrat et al, 2012 [10]	Immature Apex Pulp necrosis	5.25% NaOCl	28 days	5.25% NaOCl	Yes	Yearly	Formed apices	MTA
Lenzi & Trope, 2012 [11]	Pulp Necrosis	2.5% NaOCl	35 days	Sterile Saline	Yes	21 months	Succesful revitalization	MTA
Shivashankar et al, 2012 [12]	Pulp necrosis Coronal Fracture	5.25% NaOCl + 0.2% CHX	21days	Sterile Saline	No	1 year	Positive response to cold and EPT test	MTA
Miller et al, 2012 [13]	Pulp necrosis	2.0% CHX + 17% EDTA	42 days	2.0% CHX + 17% EDTA	Yes	18 months	Pulp vitality	MTA
Gelman & Park, 2012 [14]	Pulp necrosis Immature apex	6% NaOCl	35 days	6% NaOCl	Yes		Periapical area healed	MTA
Narayana et al, 2012 [15]	Pulp necrosis Dens in dente	5.25% NaOCl	14 days	5.25% NaOCl	Yes	1 year	Asymptomatic No increase in the root canal wall	MTA
Keswani & Pandey, 2013 [16]	Pulp Necrosis Immature Apex	5.25% NaOCl	21 days	Sterile Saline	Yes	15 months	Positive response to cold and EPT test	MTA
Forghani et al, 2013 [17]	Pulp Necrosis Crown Fracture	5.25% NaOCl	21 days	5.25% NaOCl + Sterile saline	Yes	18 months	Increased root lenghts Apical closure	MTA
Sonmez et al, 2013 [18]	Pulp necrosis Immature Apex	5.25% NaOCl	14 days	5.25% NaOCl	Yes	24 moths	Root development	MTA
Yang et al, 2013 [19]	Pulp necrosis Dens invaginatus	5.25% NaOCl	28 days	2.5% NaOCl + Sterile saline	No	24 months	Asymptomatic Normal periodontal codition	Glass ionomer cement
Noy et al, 2013 [20]	Coronal hypoplasia Immature root	2.25% NaOCl + 2.0% CHX	21 days	2.5% NaOCl + Sterile saline	Yes	4 years	Healing of the periapical radiolucency	MTA

	Periapical radiolucency							
Chen et al, 2013 [21]	Pulp necrosis Chronic apical abcess	3% NaOCl + 2.0% CHX	28 days	3% NaOCl + Sterile saline	Yes	1 year	Increased thickening of the root canal wall and lengthening of the root	MTA
Becerra et al, 2014 [22]	Pulp necrosis Chronic apical abcess	5.25% NaOCl + 2.0% CHX	26 days	5.25% NaOCl + Sterile saline	Yes	2 years	Normal periapical condition Apex closure	MTA
Lin et al, 2014 [23]	Pulp necrosis Immature apex	5.25% NaOCl	28 days	5.25% NaOCl	Yes	16 months	Pain Local sweling	MTA
Nagata et al, 2014 [24]	Pulp necrosis Immature apex	6% NaOCl + 2.0% CHX	21 days	17% EDTA + Sterile saline	Yes	19 months	Crown coloration Repair of periapical lesion	MTA
Sachdeva et al, 2014 [25]	Pulp necrosis Immature apex	5.25% NaOCl	28 days	sterile saline	No	36 months	Resolution of periapical lesion Closed apex	MTA
Santiago et al, 2015 [26]	Pulp necrosis chronic apical abcess	2.5% NaOCl	30 days	5.25% NaOCl + Sterile saline	Yes	30 months	New periapical radiolucency	MTA
Vasundara et al, 2017 [27]	Pulp necrosis Immature apex	5.25% NaOCl	21 days	sterile saline	Yes	12 months	Vitality response	MTA
Wang et al, 2015 [28]	Pulp Necrosis Apical periodontitis	2.5% NaOCl + sterile saline	14 days	sterile saline	No	30 months	Bone healing	MTA
Bekhtiar et al, 2017 [29]	Pulp necrosis	1.5% NaOCl + normal saline	3 weeks	17% EDTA	Yes	6 months	Apical closure	Biodentine

Nagas et al, 2018 [30]	Pulp necrosis	5.25% NaOCl + normal saline	28 days	5.25% NaOCl + Normal saline + 17% EDTA	Yes	60 months	Resolution of radiolucency regeneration of periradicular tissues	MTA

Discussion

Regenerative endodontics is the replacement of diseased, absent or traumatized pulp tissue. In recent years, obturations have been developed to induce the three-dimensional closure of the root canal [10, 11, 12]. In the first half of the last century, calcium hydroxide was used as a permanent rooting material [10, 11, 12]. However, it has been shown that calcium hydroxide dissolves quite rapidly in tissue fluids, so the obturation of the canal root has been improved. It is currently used in modern endodontic treatment like pulp capping and pulpotomies [12]. Nowadays, one of the most interesting experiments is the attempt to induce new connective tissues in the root canal creating a blood clot [13].

Back in 1961, Nygaard Ostby [14] insisted that a blood clot might be beneficial in healing a dental pulp, similar to the clot formed after the dental extraction, coming in 1971 with another research proving that creation of a blood clot can form a new conjunctive tissue in the root canal space. Since then, many regenerative protocols have covered the step of induced bleeding [8]. There have been reports where bleeding cannot be induced so no blood clot could be created, but the studies were declared successful. One of the biggest challenges is the suitable placement of the mineral trioxide aggregate over the blood clot in the coronal part of the root canal [8, 9].

The first selection principle of the clinical cases listed below [Table 1] is that root canal walls have not been mechanical prepared. This way, the stem cells would be protected, and the regeneration would be improved. The only needle used was in most cases #10 k-file to establish the length of the canals. In the first appointment, every tooth was isolated with a rubber dam, and access cavity was created until the exposure of the pulp. As mentioned before, the root canal length was determined, followed by copious irrigation using sodium hypochlorite, chlorhexidine, sterile saline solution or ethylene-di-amine-tetra-acetic.

An outstanding outcome was shown by Ding et al., in 2009 on a tooth with necrotic pulp and immature formed apex and chronic apical periodontitis which, after it was irrigated with 20 mL of 5.25% sodium hypochlorite solution, the tooth was sealed for only seven days with the triple antibiotic paste. In the second appointment, the antibiotic was flushed away with the same solution, and the blood cloth was created by irritating the vital tissue [15]. After the cloth was created, a grey mineral trioxide aggregate was placed over it, and the tooth was restored with resin composite [15]. After one year, the teeth regained sensibility to the tests and normal colour [15].

Like it can be seen [Table 1] sodium hypochlorite is the most used irrigation solution and can dissolve the necrotic pulp with more effect on the biofilm. Eight of the authors used chlorhexidine combined with sodium hypochlorite and one of them declared positive responses to the cold and electric tests as a result [16]. The disadvantages of sodium hypochlorite are the odor, the toxicity and the impossibility of removing anorganic components from hardly accessible anatomical areas that need to be mechanically cleaned by endodontic instruments [17]. Compared to the efficiency, sodium hypochlorite is better than chlorhexidine solution [18] but as a final irrigate compared to the saline, chlorhexidine solution has shown a greater reduction of positive cultures [19]. A study from 1998 [20, 21] showed that sodium hypochlorite used combined with chlorhexidine on single rooted nonvital teeth had better results than using them separately. It is important to say that when those two solutions are in contact, they produce a change of color and create a red precipitate [22]. Also, as a primary irrigate, ethylenediaminetetraacetic is used in only one

publication because it cannot remove the smear layer properly [23].

The mixture composed of metronidazole, ciprofloxacin, and minocycline was first tested against bacteria from carious dentin and infected pulp in 1996 [7, 24]. It is considered the most popular intracanal medicament [25]. However, two worrying reasons were that the use of minocycline, a broad-spectrum tetracycline, would cause tooth discoloration and the possibility of creating bacterial resistance [26]. It has been shown that the antibiotic paste can destroy the bacteria from dentinal tubules [7] due to its wide spectrum of action.

When it comes to the intracanal barrier, the mineral trioxide aggregate has been proven to offer a better sealing ability, biocompatibility and less cytotoxicity [27, 28]. Notably, the presence of the blood does not alter the properties of this material [28]. In 1995, Torabinejad et al. reported that the mineral trioxide aggregate, after hydration, is composed of 33% calcium, 49% phosphate, 2% carbon, 3% chloride and 6% silica so that it would prove the biocompatibility with cells and tissues [29]. Twenty-eight studies out of thirty listed below used this material as a coronal barrier.

Conclusion

The use of sodium hypochlorite and/or chlorhexidine as irrigates, a triple antibiotic paste consisting of metronidazole, ciprofloxacin, and minocycline, induced blood clot and intracanal corona barrier have shown great results over the years.

Conflict of interest: None to declare.

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ORIGINAL PAPER

Removal of definitive root canal obturation using three different tehniques

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Abstract
Introduction: In the course of time many tehniques were recommended for the removal of the root canal filling with different efficiency, time- and work exaction. The aim of this study was to evaluate the efficiency of three different methods used for guttapercha cone and sealer removal during dezobturation. Materials and methods: 63 extracted incisors after root canal preparation were filled using sealer and gutta-percha cones. After 1 week the obturation was removed using three different techniques. Teeth were sectioned to estimate the efficiency of the techniques. Preparation time was also measured. Statistical analysis was performed, at a value of $p<0.05$. Results: Visual analysis showed a more efficient cleaning of obturation when ProTaper files were used, although statistical analysis showed no differences between hand files, hand and rotary file combination and ProTaper files efficiency. ProTaper files dezobturated the canals in shortest time. Conclusion: ProTaper are recommended for root canal filling removal.
Keywords: endodontics, dezobturation, endodontic files, retreatment

Introduction

A successful root canal treatment consists in ensureing optimal conditions for the periapical tissues to heal. The healing will be possible only if the root canal was shaped, cleaned and filled as correct as possible. For the three-dimensional closure of the root canal sealers and guttapercha cones are the used materials. [1]

Although the success rate of the endodontic treatment is above 80%, in some case the retreatment of the tooth may be necessary. According to Friedman, the retreatment should not be considered a failure of endodontic treatment, rather a posttreatment disease. [2]

The American Assosiation of Endodontists defined the retreatment as a procedure to remove root canal filling materials from the tooth, followed by cleaning, shaping and obturating the canals. [3]

When retreatment needed, non surgical methods and endodontic surgery tehniques are available for doctors to choose from. The non surgical retreatment is an endodontic treatment procedure used to remove materials from the root canal space and, if present, address deficiencies or repair defects that are pathologic or iatrogenic in origin. [4]

In case of conservative retreatment- non surgical intervention-, before clearing the root canal walls from the sealers, guttapercha cones need to be removed from the canals. In the course of time many tehniques were recommended for the removal of the filling with different efficiency, time- and workexaction.

Endodontic hand –files, Nickel Titanium rotary instruments, Gates-Glidden burs, heated instruments, ultrasonic instruments, laser and different adjuctive solvents, such as halothane, chloroform, xylene or eucalypthol are used to dissolve and remove guttapercha from the root canals. [5-8]

Doctors should always keep in sight that retreatment is a tedious and time consuming procedure which can lead to many procedural error, such as ledge formation or perforation. Selecting the case for retreatment is a meticulous process where the pro- and contra-arguments of tooth prognosis need to be weighed thoughtfully. [9,10]

The aim of this study was to evaluate the efficiency of three different methods used for guttapercha (GP) cone and sealer removal during root canal dezobturation.

Materials and methods

In our study, performed at the UMFST in Targu-Mures, Faculty of Dentististry, Department of Odontology and Oral Pathology, we evaluated the efficiency of three different methods used for guttapercha cone and sealer removal.

63 incisor teeth extracted for severe periodontal affection, but clinically intact were used in the study. Teeth were cleaned and sterilized in autoclave.

Access cavity was prepared on the oral surface using diamond burs, coronal pulp was removed with a globular bur. Patency of the root canals was established with a size 10 K-file (Dentsply Mailleffer®) and 2,5% sodium hypochlorite was used as irrigant.

After macroscopic working lenght estabilishment at a powerful light-source, the root canals were prepared by the same operator, using the step-back technique. The last hand file used was an ISO number 35.

After preparation, root canals were dried using paper points and filled using Endomethasone® (Septodont®) as a sealer and gutta-percha-coins (Meta®). Lateral-condensation technique was used to close hermetically the root canals. Crowns were filled with a temporary filling material.

After 1 week the removal of the root canal filling began. Teeth were divided randomly in three groups-21 teeth in each group- and three different procedures were used as follows:
-Group 1.- GP and sealer removal using Eucalyptol and hand files (Dentsply®),
-Group 2.- GP and sealer removal using Gates-Glidden burs, Eucalyptol and hand files (Dentsply®),
-Group 3.- GP and sealer removal using Ni-Ti rotary files (ProTaper® File III, Dentsply Mailleffer®) and Eucalyptol.

In the first group Eucalyptol was plonked at the acces of the root canals to plasticize the guttapercha. The GP removal was continued using different size –from ISO size 15 to 30- hand files. Canals were irrigated abundently using sodium hypochlorite to wash out the guttapercha pieces.

In the second group after Eucalyptol dropping, the guttapercha removal was performed using Gates-Glidden burs at a rotation of 800 rot/min. After irrigation, when the tip of the bur appearently did not remove more GP, the removal process was continued using hand files, maximum ISO number 30. Canals were irrigated frequently.

In the third group after Eucalyptol was plonked on the top of the root canal, the removal of GP was performed using Rotary file ProTaper size III. The file was introduced in the canal up to the apical constriction and was moved up and down, until apparently no more guttapercha was removed. Irrigant was used to wash out the remaining GP pieces.

The removal of guttapercha was considered finished, when no more material was observed on the instruments.

In each group we measured the needed time for the GP removal. After removal of guttapercha, teeth were sectioned usig a disc. (figure 1,2,3)

Figure 1.
Sectioned teeth after obturation removal using Eucalyptol and hand files

Figure 2.
Sectioned teeth after obturation removal using Eucalyptol, Gates-Glidden burs and hand files

Figure 3.
Sectioned teeth after obturation removal using Eucalyptol and Ni-Ti rotary files

The efficiency of the obturation removal was evaluated as follows:
1– no visible obturation on the root canal walls
2– only visible sealer
3– small quantity of sealer and GP present
4– a considerable amount of sealer and GP present

Statistical analysis was performed using Chi2 test to evaluate if the used methods efficiency are significantly different from each other. Statistical significance level was set at a value of $p< 0.05$.

Results

Or results after root canal filling removal in the three groups are presented in Table 1.

Statistical analysis using the Chi2-test showed no significant difference between the found values in the three groups. (Table 2)

Table 1. The number of samples in each group with the mentioned values (1– no visible obturation on the root canal walls, 2– only visible sealer, 3– small quantity of sealer and GP present, 4– a considerable amount of sealer and GP present) after evaluation of root canal filling removal

Values	Group 1	Group 2	Group 3
1	6 (28,5%)	1 (4,7%)	3 (14,5%)
2	3 (14,5%)	8 (61,7%)	14 (66,3%)
3	6 (28,5%)	6 (28,5%)	3 (14,5%)
4	6 (28,5%)	6 (28,5%)	1 (4,7%)

Table 2. -Statistical analysis of the found values after filling removal in the three groups

	1	2	3	4	*Row Totals*
Group 1	6 (3.33) [2.13]	3 (8.33) [3.41]	6 (5.00) [0.20]	6 (4.33) [0.64]	21
Group 2	1 (3.33) [1.63]	8 (8.33) [0.01]	6 (5.00) [0.20]	6 (4.33) [0.64]	21
Group 3	3 (3.33) [0.03]	14 (8.33) [3.85]	3 (5.00) [0.80]	1 (4.33) [2.56]	21
Column Totals	10	25	15	13	63 (Grand Total)

p=0.013093. The result is significant at p <0 .005.

The time needed for guttapercha removal for each tooth in the three groups is presented in figure 4.

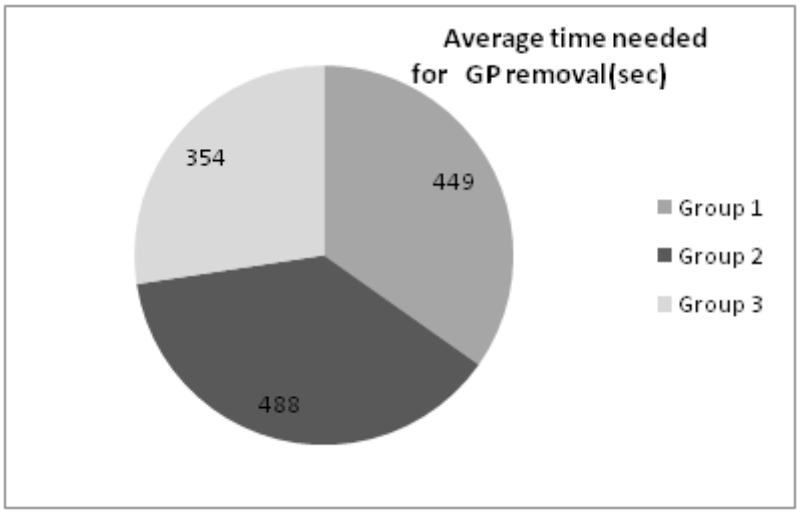

Figure 4. The needed time for guttapercha removal expressed in seconds

The root canal obturation was removed in less time using Ni-Ti rotary files and Eucalypthol. Dezobturation using only hand files and hand files combined with Gates-Glidden burs and Eucalypthol needed almost the same amount of time.

Discussion

Root canal system anatomy plays an important role in endodontic treatment success and failure.

Endodontic failures occure in case of inadequacies in shaping, cleaning and

obturation, iatrogenic events or re-infection of the root canal system when the coronal seal is lost after root canal obturation. To correct the failures doctors should decide among nonsurgical retreatment, surgical retreatment or extraction. [3,4,9]

Nonsurgical endodontic retreatment procedures present a high success rate if the teeth are selected correctly and precise techniques are utilized.

The first step of a proper retreatment consists in the removal of the root canal obturation-guttapercha cones and sealer.

For the removal of guttapercha several methods and combination of methods are described in the literature. Hand and rotary files, different solvents and Ni-Ti rotary systems are used for cleaning the root canal from the obturation. [11,12]

Based on our results, Ni-Ti rotary files (ProTaper, Dentsply®) removed the guttapercha most efficiently and with the less time needed compared to the other two methods- hand files, rotary and hand files combination. Eucalyptol was choosed as solvent, because of its benefical properties discribed in literature- such as antibacterial effect or decreased irritative chances than other solvents-, although Xylol is more effective according to several studies. [7,8]

In the first group, where conventional hand files and Eucalyptol were used for removal of the guttapercha cones and sealer made possible a dezobturation time 39 seconds faster and a more effective cleaning of root canals, than in the second group, where rotary files (Gates-Glidden) were used in combination with Eucalyptol and hand files.

The best tehnique from the three used in this study for the removal of definitve obturation turned out to be the use of ProTaper files and Eucalyptol, which was the most effective and the fastest also. Thus, we did not found statistically significant differences between the three groups when analysing the efficiency of the tehniques. Our results are similar to other studies about removal of root canal obturation. [13-17]

Conclusion

Although no statistically significant differences were found between the studied groups, based on visual analysis the Ni-Ti rotary endodontic files turned out to be the most efficient in removal of definitive root canal fillings.

Conflict of interest: None to declare.

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ORIGINAL PAPER

The option for prosthetic treatment determined by social and economic factors.

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Abstract
Fixed mixed restorations are frequently realized in prosthodontics. The purpose of the study was to analyze comparatively the frequency in realization of fixed prosthetic restorations, represented by metal-polymeric and porcelain fused to metal bridges, in private practice, in patients living in rural and urban area.
95 patients, 42 of rural and 53 of urban area were selected for this study. The selected clinical cases were compared after the achievement of prosthetic restoration (metal-polymeric and porcelain fused to metal bridges), to determine the causes of choosing of the type of prosthetic treatment plane. The selected patients received 114 fixed mixed restorations, represented by 70 metal-polymer (FMMP) and 44 porcelain-fused-to-metal (PFM) bridges. The distribution of FMMP restorations were 59 for patients of rural area and 11 for the patients of urban area. All 44 PFM restorations were achieved for the patients of urban area.
In some situations, the adopted prosthetic treatment plan may represent a compromise solution in terms of the optimal resolution of the case, due to the local or general particularities of patients, or due to the objective/financial factors.
Key words: fixed prosthetic restorations, metal-polymeric bridges, metal ceramic bridges

Introduction

Coronary destruction and partial edentations are clinical situations frequently encountered in dental practice [1]. The variety of clinical cases facing the practitioner is a very important element in selecting the options for the establishment of the prosthetic treatment plane [2,3].

Coronary destruction and of partial edentations determine undesirable local changes in the functions of the orofacial system, which are accompanied by negative effects on the whole body, and, last but not least, by the psychological impairment of the patient [4,5].

The most common local complications are represented by the esthetic and phonetic disturbances, masticatory disorders, tooth migration, periodontal affections, occlusal disturbances, and dental abrasion [6].

Fixed mixed prosthetic restorations are frequently realized in prosthodontics [7].

The purpose of the study was to analyze comparatively the frequency in realization of fixed prosthetic restorations, represented by metal-polymeric and porcelain fused to metal bridges, in private practice, in patients living in rural and urban area. To achieve the purpose of the study, were analyzed in the dental offices the various clinical cases.

Material and methods

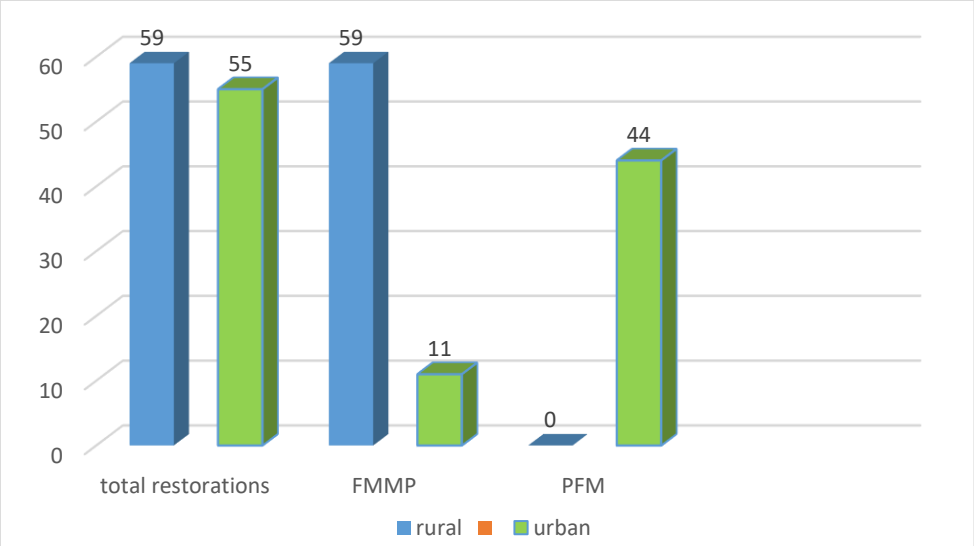
The study was realized in conformity with the ethical principles and the good clinical practice. All selected patients understood and signed the written informed consent prior the initiation of this research. The researches were realized in 22 private Romanian dental offices, of which 10 were located in the rural area and 12 in the urban area. Of the 100 selected patients, at the final of researches remained only 95 (42 patients of rural and 53 of urban area). The inclusion criteria were represented by the healthy patients, with ages between 31-50 years and the presence of extended dental coronary destruction and of partial edentations restored by dental bridges.

To achieve the purpose of the article, we analyzed in the dental offices the various clinical cases. The metallic component part of all manufactured restorations were by Remanium alloy. The polymeric component part were represented by the baro-polymerizated dental resin, and the ceramic

component part by the porcelain realized by the additive method.

Results and discussions

The selected 95 patients received 114 fixed mixed restorations, represented by 70 metal-polymer (FMMP) and 44 porcelain-fused-to-metal (PFM) bridges. The distribution of FMMP restorations were 59 for patients of rural area and 11 for the patients of urban area. All 44 PFM restorations were achieved for the patients of urban area (Graph 1).



Graph 1. The distribution of the fixed mixed restorations

For illustration, we present two of the solved cases by fixed mixed restorations, one by metal-polymer (FMMP) and one by porcelain-fused-to-metal (PFM) fixed prostheses.

The first cases is a 44-year-old female, which came to the dentist's office invoking the dysfunctional mastication, respectively the disturbed phonetics and aesthetics. The clinical examination revealed root fractures, changed color of the physiognomic component part, gingival recession, unsatisfactory aesthetic appearance.

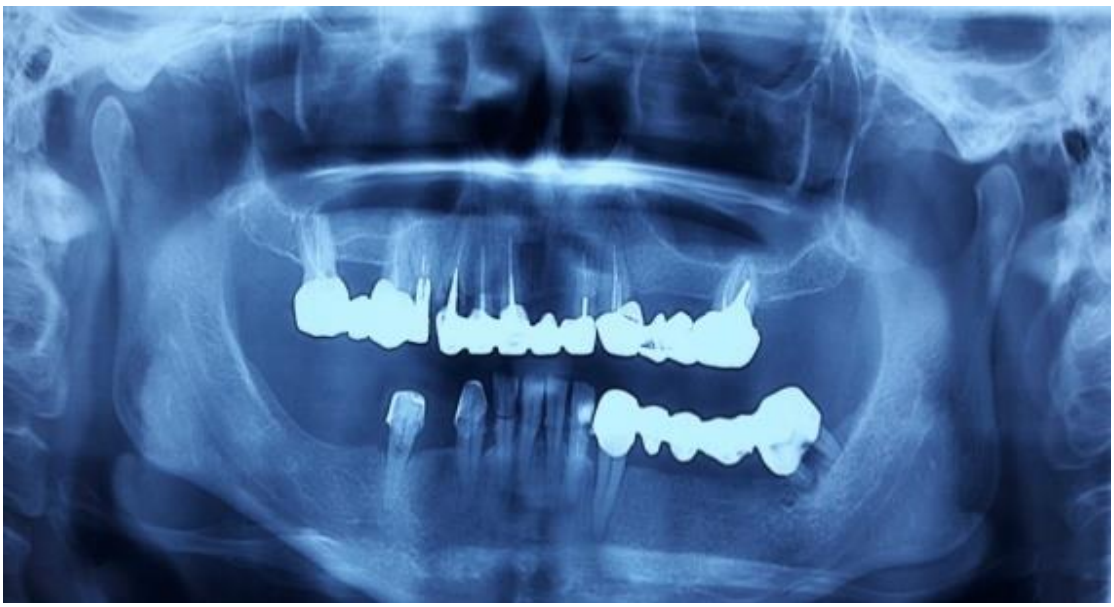


Figure 1. The initial situation

The edentation diagnosis (figure 1) was maxillary IInd Class Kennedy edentation with 3 modifications (absence of teeth 1.6, 2.1, 2.4, 2.5, 2.7), and mandibular IInd Class Kennedy

edentation with two modifications (absence of 3.4, 3.5, 3.6, 4.4, 4.6, 4.7). The adopted treatment plane was represented by the ablation of old prosthetic restorations with the pillars 1.4, 1.5, 1.7; extraction of 1.4; performing the endodontic treatment on tooth 1.3 (for metallic post and core, impression and, than, placement of metallic post and core) and of tooth 2.2 (reconstructed with glass fiber core and glass ionomer cement). The pillars were prepared by the same grinding techniques, the impression of prosthetic field was performed with condensation silicone material.

The next stage was represented by: the try-in of the metallic component on the pillars (verifying the marginal adaptation, the occlusion, the contact of mucosal area of pontic with the edentulous ridge, the dimensional verification of the bridge and its integration into the arch with respect to the sagittal and transverse occlusion curves – figure 2); the selection of the color shades for the esthetic component part; the insertion on pillar teeth, the adaptation and the temporary cementation of mixed metal-polymeric restoration, followed by the size, color and shape of realized bridges, including the marginal adaptation of the aggregation elements to pillar teeth, their proximal adaptation to the neighbor teeth, occlusal and mucosal adaptation of the prosthetic work, their integration on the dental arch with respect of the sagittal, transversal curves; the final cementation with of glass ionomer cement (figure 3).

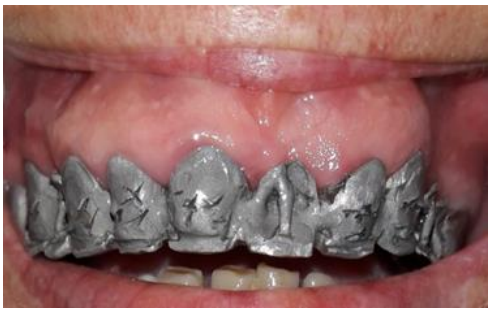


Figure 2. Try-in of the metallic component part in the oral cavity

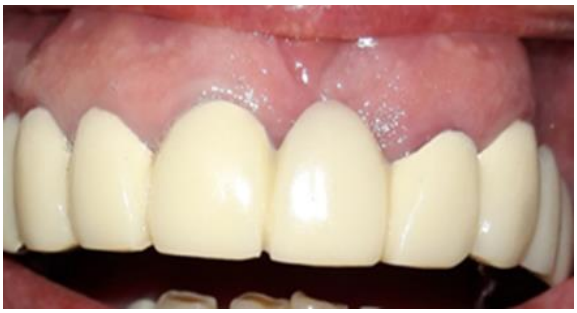


Figure 3. Final cementation of the fixed prosthesis

The second selected case is of a 44 age old patient, who came to the dental office for the restoration of the masticatory function, affected by the loss of teeth 3.6 (figure 4). The edentation diagnosis was IIIrd Class Kennedy edentation. The treatment options choses after the discussion with the patient was the realization of a PFM fixed restoration with the aggregation elements on teeth 3.5-3.7 and with the pontic covered in totality with the porcelain. The phases of the prosthetic treatment consisted in the patient's health education, preparing of the local pre-prosthetic field, preparation of abutments, impression of prosthetic field, the effectuation of the laboratory phases and of the post-prosthetic treatment. It was necessary to realize the devitalization at the level of 3.7 (due its large coronal destruction) for the achievement of a post and core for the crown coverage (figure 5).

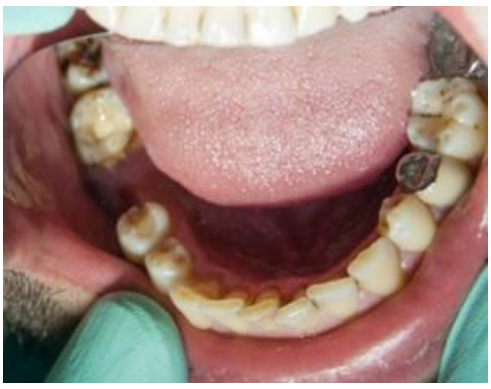


Figure 4. The initial situation

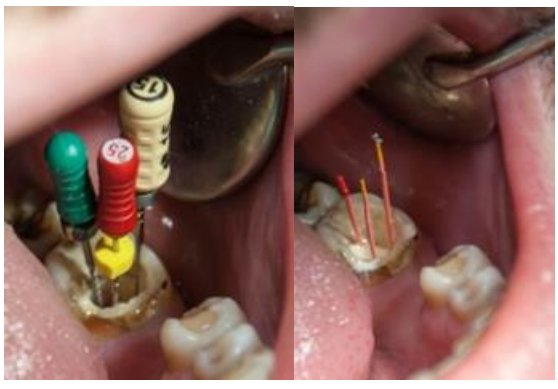


Figure 5. Endodontic treatment

In order to ensure the necessary space for the metallic component part and for the ceramic one the abutments were prepared almost 2mm in profundity and with buccal cervical shoulder of 0.5mm, for aesthetic reasons. In figure 6 is presented the try-in of the metallic component part in oral cavity. The provisional cementing of the PFM bridge was followed by the final cementation effectuated after 3 weeks. The patient' follow-up continued with their oral health education about the sanitation of the fixed restorations as well as of the remaining teeth after 6 months (figure 7).

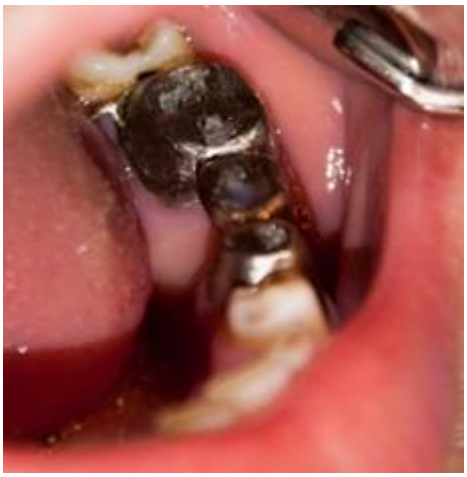


Figure 6. The try-in of the metallic component part in the oral cavity

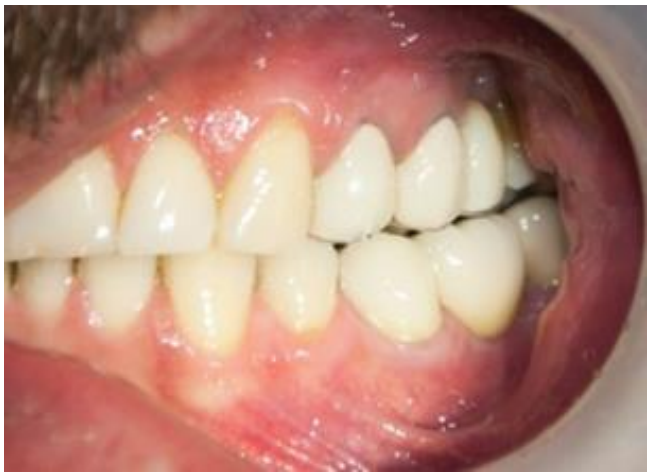


Figure 7. Final cementation of the fixed prosthesis

PFM bridges shows optimum mechanical resistance and esthetic features, reason of which is superior to the metal-polymer bridges. In all studied cases, the chosen variant of prosthetic treatment plane was determined by the socio-economic considerations of the patients.

In defiance of the competition among metal-polymer and metal-ceramic fixed restorations, the first ones represents still in present of the most widely used types fixed esthetic restorations, because the combination of the polymeric esthetic component part with the metallic component represent a success regarding the cost of this type of prosthetic restoration. Compared with porcelain fused to metal fixed restorations, an important disadvantage of metal-polymeric restoration is represented by the accentuated reductions of dental hard tissues especially on the labial/buccal surfaces of pillars, often followed by endodontic treatment [8].

Many researchers suggest that patients with low social and economic conditions have the tendency to undervalue their level of dental healthcare demands [9-12].

Costs and risk assessments influence the selection of mixed fixed restoration type and the prognosis [13].

Sometime, removable dentures represent, even at present, a viable dental treatment alternative, especially in the cases where the fixed mixed prosthetic restorations cannot be realized due to the clinical, technical or social and economic conditions [14-17].

The limitations of findings are represented by the reduced number of studied cases and further researches, on a large number of patients, are required.

Conclusions

- In some situations, due to the local or general characteristics, or due to objective, financial factors, is required to elaborate prosthetic treatment variants with few compromises in terms of optimal resolution of the patients' case.
- The solved cases by the use of metal-polymeric restorations suggest the conclusion that there are restored optimally the masticatory function and satisfactorily the esthetics function, which is why they are preferred by patients with more limited financial possibilities

Conflict of interest: None to declare.

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CASE REPORT

Management of implant fracture: a clinical report

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Abstract
Implant fracture is a rare complication of dental implant treatment, but this complication represents failure of treatment. A case of fracture of an endosseous dental implant occurring in a middle-age woman, 18 months after placement is reported. The implant replaced the mandibular first premolar in a four-unit bridge supported by two implants. The treatment plan consist of placement of additional implants simultaneous with removal of the fractured implant and reconstruction of bone loss. The bone collected from implant placement and implant removal was used to regenerate surgical site.
Keywords: dental implant complication, implant fracture, occlusal load, management.

Introduction

Dental implants are widely used in dentistry and despite its high success rate initially reported, increases the occurrence of accidents and complications [1,2].

Many papers describe accidents and complications associated with dental implants therapy. Comparison between different data in dental literature is often difficult due to different classification criteria and due to confusion among accidents and complications.

Accidents are local events that occur during surgery and complications are conditions which appear postoperatively [3]. According to these authors complications of dental implant treatment are classified in early and late complication. Late complications are: perforation of mucoperiosteum, maxillary sinusitis, mandibular fractures, failed osseointegration, bony defects, periapical implant lesion, infection and implant fracture.

The incidence of implant fracture is small [4,5], but represents the failure of implant therapy and can be a delicate problem for dental team, because it usually involves loss of both the implant and the prosthesis.

This paper presents the management of implant fracture with reassessing the treatment plan.

Case report

A 47-years old woman make an appointment accusing raised mobility of a fixed implant-supported prosthesis, cemented 18 months ago. The clinical examination revealed a porcelain-fused-to-metal 4-unit mandibular bridge supported by two osseointegrated implants. The fixed prosthesis replace both premolars, first and second molar and implants replaced first premolar and second molar.

The bridge was easily removed together with the fractured implant coronal portion (figure 1).

The treatment plan consist of placing additional implants for second premolar and first molar, removing fractured implant with piezotome, reconstruction the bone defect. After four months a new implant will replaced first premolar and final restauration will be a four-unit fixed partial denture supported on four implants.

Under local anaesthesia (Articaine® 1:100,000 Epinephrine) a mucoperiostal flap was elevated exposing the fractured implant and one adiacent tooth along with posterior implant (figure 2).

Initially, the sites for implants that replaced second premolar and first molar were prepared. A trephine bur was used to collect bone from osteotomy sites (figure 3). Two implants were placed and then piezotome was used for osteotomy with the purpose of removing fractured implant together with surrounding bone (figure 4,5).

A mixture of autologous material, consisting of harvesting bone from implant sites, bone block from fractured implant and patient blood, and particulate xenograft from bovine material was prepared to regenerate surgical site and promote bone augmentation (figure 6,7,8).

A fixation screw hole was pre-tapped before block removal from donor site. The surgical

site was filled with mixture between particulate autologous bone and xenograft (figure 9) and fixation was done to secure the bone block (figure 10). The fixed block was covered with a cardiac membrane and sutures were done in two layers with 4-0 polypropylene (figure 11).

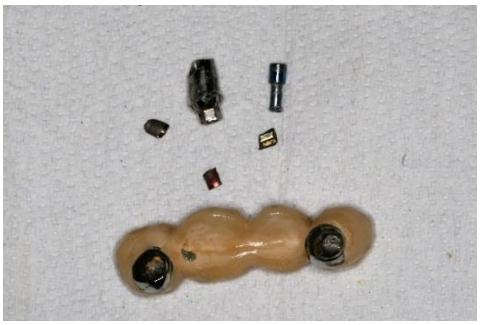

Figure 1.
Patient presented with a loose dental bridge. One implant is fractured and also one screw abutment.

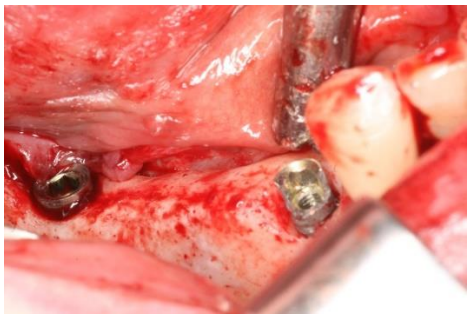

Figure 2.
Exposure of the bone with a full thickness flap utilizing a mid crestal incisions.

Figure 3.
Bone harvesting with trephine bur from new implant site.

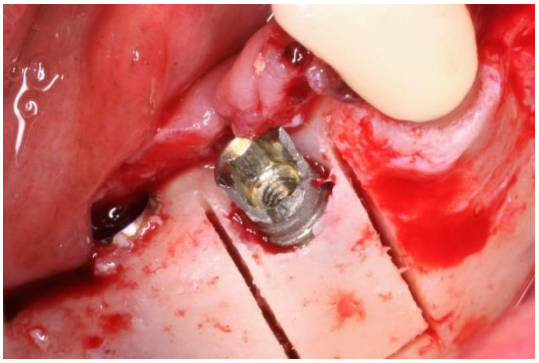

Figure 4.
Placement of additional implants and osteotomy around fractured implant.

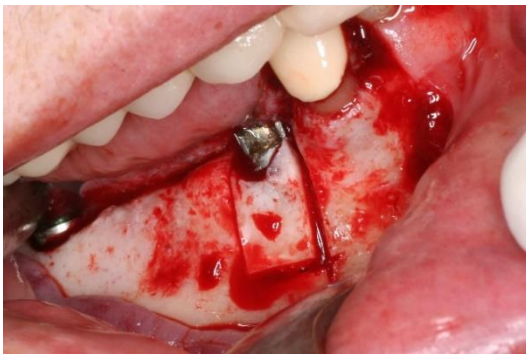

Figure 5.
Ostetomy of cortical bone around fractured implant.

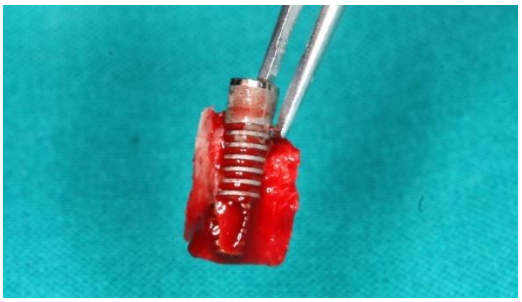

Figure 6.
Osseointegrated implant removed with adjacent bone.

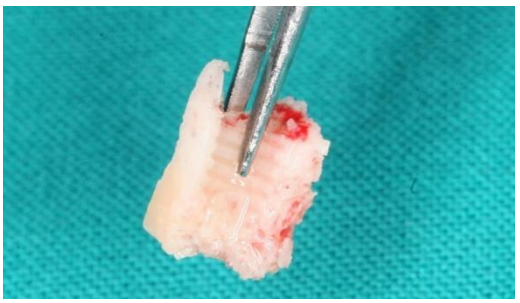

Figure 7.
Implant surrounding bone was collected and prepared to use as bone block to graft osteotomy site.

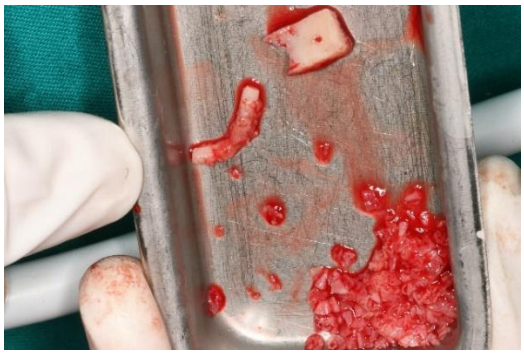

Figure 8.
Mixture of autologous material and xenograft soaked in patient venous blood.

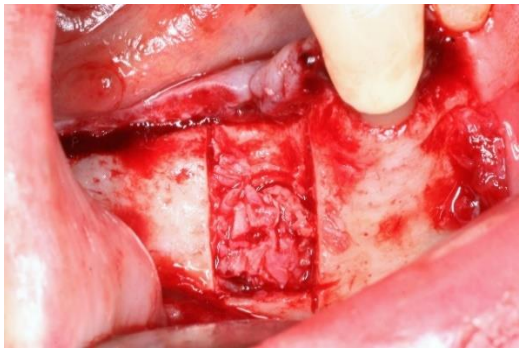

Figure 9.
Surgical site filled with particulate bone.

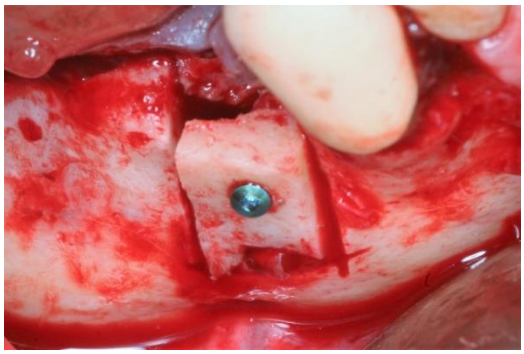

Figure 10.
Fixation of bone block.

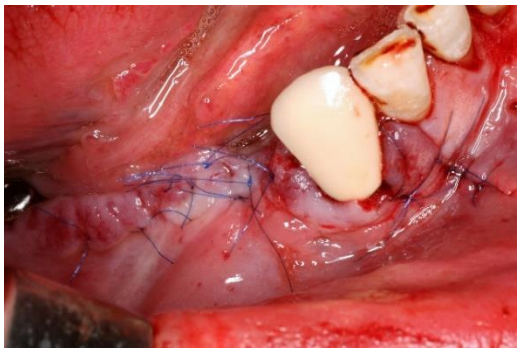

Figure 11.
Postoperative aspect.

Discussion

Implant fracture is a rare complication: 2 cases of 2000 implants after Gargallo Albiol J. et al. 2008 [6]. This complication is more frequent in case of small diameter implant, especially in posterior region where is high occlusal load [7,8]. Also narrow-diameter implants were associated with abutment fracture [9] and more marginal bone loss compared with regular-diameter implants [10].

Causes of implant fracture are: manufacturing-induced fracture, restoration-induced fracture and overloaded-induced fracture [11]. Defects in the production and design of dental implants are very unlikely reasons for fracture [11].

The most common cause for implant fracture seems to be physiological or biomechanical overload. The stress caused by retaining screws of prosthesis without passive fit may result in continuous tension on the implant, predisposing to fracture. Frequently, loosening the screw of implant is a warning sign related to restoration supported by implant and precedes implant fracture [12].

Main cause is bone loss or overload of implants (incorrect restoration, bruxism). Parafunction like bruxism is identified as major etiological factor related with implant fracture [13]. Load factors are related to the magnitude and direction of occlusal forces. Majority of endosseous implant fractures are located in the molar and premolar area, where chewing forces and lateral movements associated with cusp inclination generate detrimental forces [14,15].

In this case, two implants, which replaced first premolar and second molar, supported a four-unit bridge in lateral area. According to Misch and Resnik [16] there are key implant position in order to withstand to occlusal load. The key implant positions when missing premolars and molars are: first premolar and second molar as terminal abutments and first molar to support high occlusal forces. First molar has a key position, for both maxilla and mandible, because occlusal load doubles at first molar compare with premolar area. Rarely, two implants are sufficient to replace four posterior teeth.

Management of implant fracture includes: removal of fractured implant, replacement of implant and fabrication of a new prosthesis or modification of existing prosthesis leaving fractured implant in place.

Removal of fractured implant and replacement includes following options:

- immediate replacement with a wider diameter implant,
- simultaneous replacement with guided bone regeneration,
- delay approach with rebuilding of the lost tissues and implantation after site healing.

The purpose of treatment plan was to fabricate an implant-supported fixed partial denture able to support occlusal load in lateral area of a health adult female patient with antagonist tooth-supported fixed partial denture. The new prostheses will be supported be four implants and failed implant will be replaced be a wider diameter implant.

Due to complexity of the case the following treatment plan was establish: placement of two additional implants simultaneous with removal of fractured implant and grafting the surgical site. Placement of a new implant in grafted site and fabrication of a new prosthesis: four-unit splinted fixed partial denture.

Piezosurgical removal of fractured implant was performed because it has the advantages of easy control, selective cutting, and rapid healing [17].

Because complete removal of the implant could result in significant bone loss [18], implant site were regenerated with bone graft and a mixture of particulate bone. Four months later a new implant could be placed.

Adequate prosthetic planning is essential to reduce dental implant fracture rates: biomechanical factor and achieving a passive fit of the prosthetic restoration must be taken into consideration from the moment when is elaborated the treatment plan, continuing with implants placement until prostheses are installed.

Conclusions

In this case management of fractured implant consists in removing the fractured part and grafting the surgical site for placing a new wider diameter implant later. Bone collected from surgical site was used to its reconstruction.

Conflict of interest: None to declare.

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CASE REPORT

Bone reconstruction in severe defects of the mandibular residual ridge in oral surgery.

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Abstract

Dental implants placement is often limited by the anatomy of the alveolar bone. Patients often lose their teeth due to alveolar bone resorption, tooth extraction, trauma thus making it difficult to place implants in an optimal prosthetic position. The loss of width of the residual alveolar ridge that is needed to place implants often needs a remodeling of the lost dimensions.

This case reports the successful management of such a patient where the placement of implants possible by autogenous bone block graft techniques obtained from the external oblique line of the mandible with predictable osseointegration and implant stability.

Keywords: dental implant complication, implant fracture, occlusal load, management.

Introduction

The placement of dental implants is frequently restricted because of the quality and quantity of the available alveolar bone. [1-3]

The adequate bone volume necessary for the insertion of dental implants is many time decreased after the loss of the teeth, after facial trauma, affections of the periodontal tissues, and other dental pathologies. [1,4,5]

Autogenous bone grafting techniques have been documented to have a high effect in the reconstruction of jaw anatomy, esthetics restaurtions and biomechanical support for dental implants placement. [6,7]

The bone block autografts utilisation is indicated when is desired an increased volume of the bone ridge, especially for the development of an implant site. [1,8]

The advantages of the autograft bone blocks is that they maintain bone structures like minerals, collagen, viable osteoblasts and bone morphogenic proteins with the disadvantage of the morbidity of the second surgical site. [5,9-11]

The case presented in this article clinically demonstrates the efficacy of using a block graft for dental implant placement in the lateral mandibular region.

Case report

A 36-old male patient, P.C., without medical history, has presented in our clinic for initial consult. The initial clinical examination revealed partial edentoulism in the fourth quadrant, more precisely missing teeth in the position of 4.5. and 4.6., as well as the presence of decays on several teeth. According to the anamnesis the patient experienced extractions of the two missing teeth 2 months earlier in an another dental office.

The radiological examination, by CBCT scan (figure 1), revealed the presence of a residual granuloma next to the apex of the extracted tooth 4.5. In addition, the alveolus of the extracted tooth 45 was partially mineralized and its buccal cortical plate was missing. In position of tooth 4.6. the edentoulus ridge is almost sufficient for implant insertion.

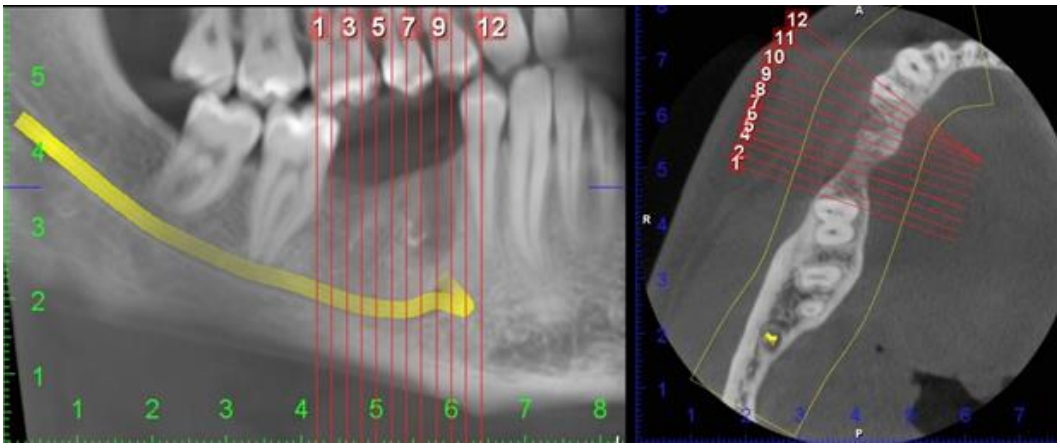

Figure 1. Preoperatory CBCT

Because of the insufficient bone width of the surgical site, the treatment plan includes a bone augmentation technique with intraoral harvested bone graft from the external oblique line. The surgery includes simultaneous implant placement, a 3,75 mm diameter and 13 mm length implant in the position of the 4.5. missed tooth, and a 4,2 mm dimater implant with a 11,5 mm length in position of 4.6. missed tooth.

The implant osteotomy for 45 was performed with high precautions in preserving the integrity of the inferior alveolar neurovascular bundle. The bone gap consisting of the missing buccal cortical bone plate will result in creating a neoalveolus, which will have only three bone walls to surround the implant surface. This clinical situation is in favour for a simultaneous bone block with implant insertion technique, because the neoangiogenesis process, which will provide the surgical site with mesenchymal stem cells, will take place inside of the bone contour. Subsequently the healing process will be similar to that of an postextractional socket.

Local anesthesia by infiltration, respectively, peripheral troncular anesthesia for the inferior alveolar nerve was performed. The anesthesia technique did not include the buccal nerve, which was additionally anesthetized. The used substance is articaine hydrochloride with the highest adrenaline concentration (1: 100,000), named Ubistesin Forte®.

Before the surgical procedure a small quantity of blood was drawn form the patients peripheral vein. 9ml of blood were trasferred into 6 blood collection tubes with clot activator (Vacutest Kima® srl, Arzergrande, Italy), with the purpose of creating PRF membranes (figure 2).

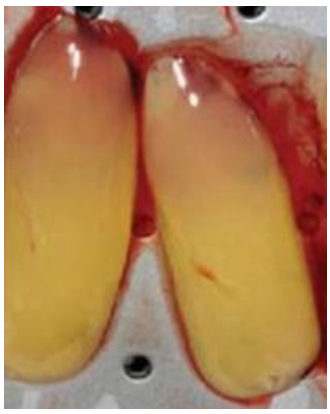
Figure 2. PRF membranes

The preoperative medication consists of amoxicilyn and clavulanic acid 2 g and dexamethasone 8 mg i.v. to reduce the postoperative edema.

Incisions were performed on the middle of the edentoulus ridge, as well as two releasing incisions next two the canine and the third molar and an intrasulcular incision around teeth 4.4., 4.7. and 4.8. (figure 3). All of them were performed with the aid of a 15C scalpel blade. As a result a mucoperiosteal flap, with a trapeziodal contour, was elevated from the mesial vertical releasing incision, with the aid of a surgical tweezer and a periosteal. During the mucoperiosteal flap elevation the mental nerve is highlighted and isolated to avoid its injury during implant osteotomy.

When bone augmentation techniques are intended, both with bone block or just bovine bone grains, the surgeon must consider to create large, extended flaps to gain a certain elasticity, in order to avoid tension or pressure on the augmented site. Unfavorable tension could lead to complications by dehiscnece,

followed bone graft exposure and possible infection.

The trapeziodal mucoperiosteal flap which was chosen in this clinical case, is the most common type of flap used in oral surgery. It provides excellent access, produces no tension and allows an easy reapproximation to its original position, hastening in this way the healing process.

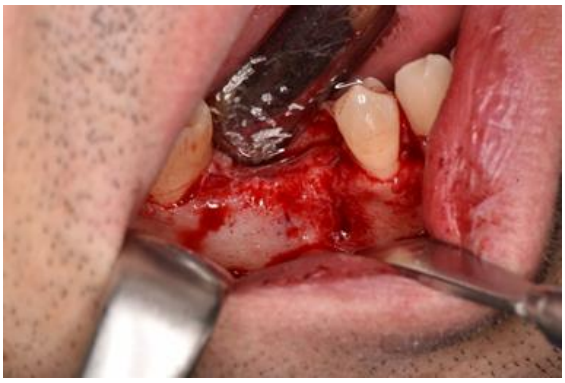

Figure 3. Mucoperioseal elevation and aspect of the bone defect

The bone block is harvested with the aid of the piezosurgery unit (Mectron® S.p.A, Carasco, Italy), using the micro-saw shaped OT7S insert. Four osteotomy grooves are performed in the external oblique line of the mandible to define the contour of the bone block in a rectangular form. To choose the exact dimension of the bone segment to be harvested, a sterile paperboard form the suture pack was used as a frame and helped the surgeon in designing the contour of the bone block. Constat irrigation with saline solution is necessary to avoid excessive frictional heat and subsequent necrosis. The highest temperature, considered safe enough when creating the osteotomy lines is 47°C.

The block was then removed by a straight, thin chiesel with necessity of hammering. The bone block is split into two thinner blocks with a diamond disk, and finished with a diamond round bur and straight handpiece. The finishing process is necessary to avoid sharp margins, which can lead to surgical wound dehiscence. With the aid of a special designed drill (ACM –drill), small autogenous bone chips are harvested.

Next, the implant osteotomy preparations are created step by step with the drills from the ARDS® implant kit.

After marking the correct position of the future implants on the bone ridge, the pilot drill is inserted only up to 5,5 mm to verify and correct, if necessary, the implant direction. Using a parallel guide pin preparation it can be easily checked if the position is parallel to the adjacent tooth 4.4. (figure 4).

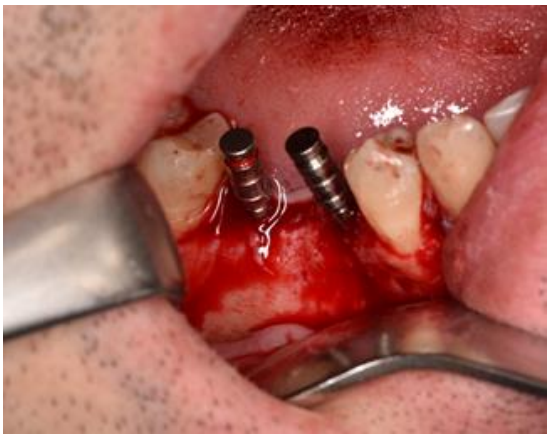

Figure 4. Parallelisms of pin placement

The guide pin also serves to check the future implant position to the occlusal plane. The angle and direction of the drill is corrected according to the parallel guide pin and then the osteotomy drill is inserted up to the final length of the desired implant. In addition, for both implants, the preparations will be 1mm deeper (13 mm plus 1 mm for 4.5. and 11,5 mm plus 1mm for 4.6.). The significance of this type of osteotomy is the 0,5 mm subcrestal implant placement and on the implant apex must not apply pressure on the bottom of the preparations.

Using successive thicker drills from the implant kit, the size of the osteotomy will gradually increase. For an implant diameter of 3,75 mm the last drill has a 3,65 diamater and for the 4,2 mm implant diameter, the last drill has a 4,0 mm diameter.

To improve angiogenesis and to stimulate the migration of mesenchymal stem cells in the recipient bed, several holes are drilled into the buccal cortical bone plate (figure 5). In this purpose a straight handpiece is used and a special spear drill is inserted up to 2-3 mm in the trabcular bone. Bleeding of the recipient surgical bed is a good sign of future agiogenesis process for the integration of the bone graft.

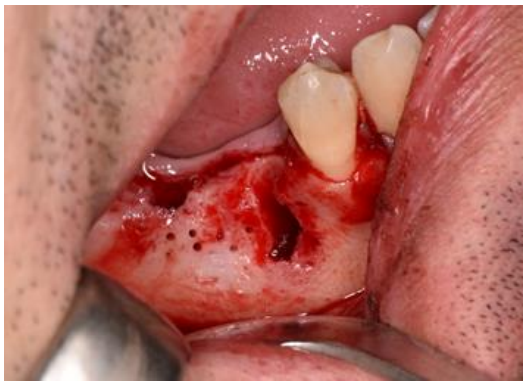

Figure 5. Preparation of implant neoalveolae and selective trepanation of buccal cortical bone

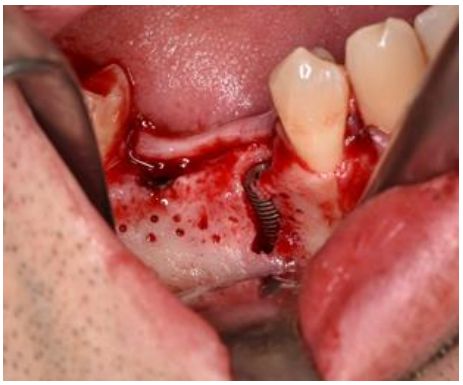

Figure 6. Implant insertion

Implant insertion is performed with the dynamometric ratchet with the highest insertion torque of 50 Nm. A higher force for implant placement may conduct to a unfavorable higher pressure on the bony walls of the preparation, which leads to bone resorbtion and consequent implant failure. To prevent microbial colonization because of the restant blood inside the implant, this one will be cleaned with saline solution and antiobiotic gel will be applied before cover screw insertion.

The implant placement is followed by the rigid fixation of the bone block by the aid of osteosynthesis screws, from Devemed®, and a special designed screwdriver from STOMA company. The two bone blocks are fixed one after the other, next to implant 4.5. and distally for 4.6., each of them with one osteosynthesis screw (figure 7).

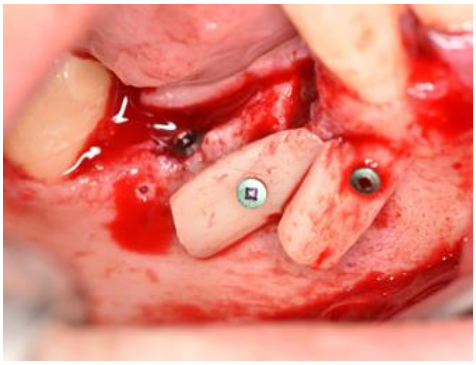

Figure 7. Placement of cortical bone blocks with osteosinthesis screws

After the rigid fixation of the bone blocks, bone chips were applied as an inside lining of the bony framework. The bone chips were plugged between the implant body and the bone block, and between the cortical bone plate of the mandible and the other bone block (figures 8,9).

Excessive plugging must be avoided, because the space between the thiny bone fragments allows neoformation of blood vessels, in the entire structure of the graft, in order to contribute to integration and neoformation of bone tissue. The PRF membranes (figure 10) are used to create an ouside lining for the bone graft, without additional need to apply low resorption rate membranes (up to 4-6 months), like pericardium membranes.

The mucoperiosteous flap suture was performed according to horizontal mattress suture technique, with polypropylene, monofilament sutures (figure 11). A 6.0 thickness thread and needle with triangular shape in cross section with 10 mm and 12 mm length were chosen. The sutures were removed 10 days after the surgery, when a small dehiscence next to implant 4.5. was observed. The cover screw was removed and a healing abutment was inserted instead to avoid debris to enter underneath the flap.

Figure 8. Patient harvested bone

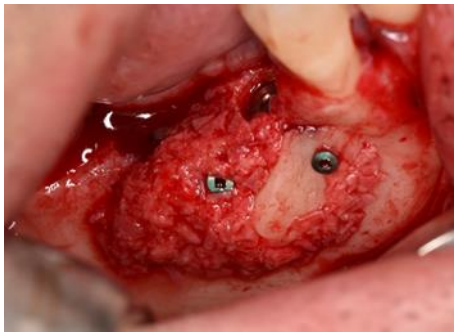

Figure 9. Covering of the cortical bone blocks with autologous bone particles

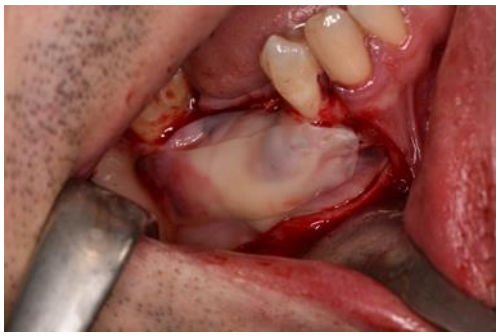

Figure 10. Placement of PRF membranes

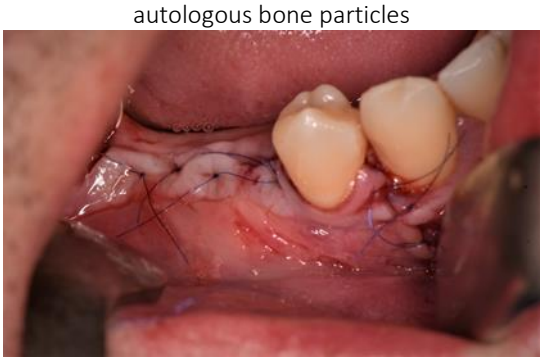

Figure 11. Suture

Immediatelly after the surgery a panoramic x-ray was performed. The first postoperative check was performed 48h after the intervention, and then every 25 days (figure 12).

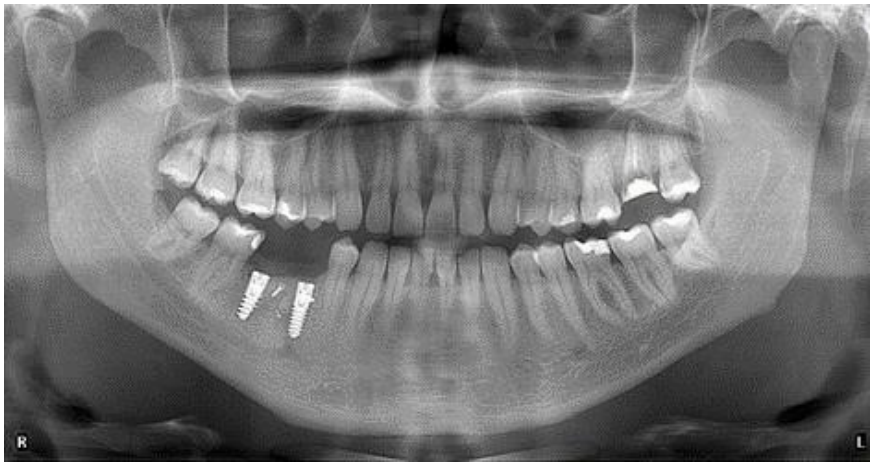

Figure 12. Postoperatory Rx

After 3, 12 and 24 months postoperative CBCT were performed to analyse and verify the bone graft created in the surgical site, as well as its volume preservation in time.

Three months after the procedure the patient was recalled (figure 13) for implants uncovering. Intraoperative examination proved the integration of the bone blocks, and of the autologous bone chips.

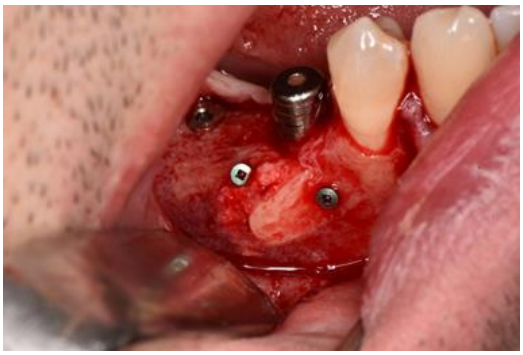

Figure 13. Bone graft aspect at three months post op

The new formed bone is not completely mineralized yet. New formed blood vessels can be observed on the surface of the integrated bone graft. The cover screw from implant 4.6. is removed, the implant screw channel is cleaned with saline solution and the healing abutment is inserted for implant 4.6. as well. Suture is peformed with polypropylene 6.0 thread and 12 mm long needle. At this point the implant stability is measured with the Osstell® (Osstell AB Goteborg, Sweden), showing 82 ISQ for implant 4.5. and 85 ISQ for implant 4.6. (figures 14, 15).

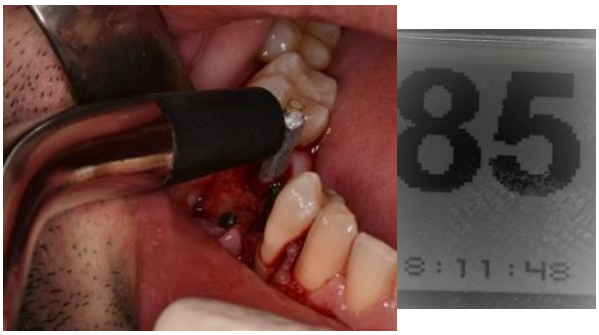

Figure 14. Measuring the stability of 4.6 with OSSTELL®

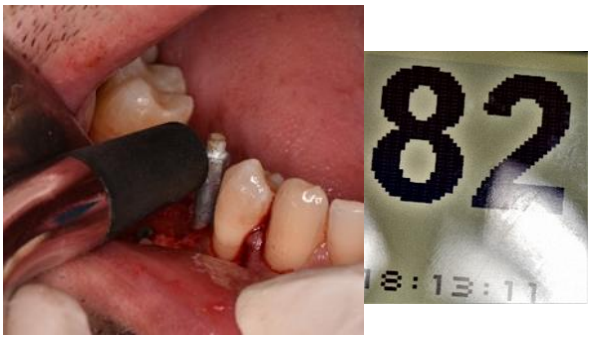

Figure 15. Measuring the stability of 4.5 with OSSTELL®

Osstell® values under 60 ISQ are correlating with a poor implant stability, those between 60-70 ISQ are meant for a medium implant stability and higher than 70 ISQ values indicate a good implant stability. The measured values in this clinical case (80 and 82 ISQ) are excellent results considering the implants stability in grafted bone site with bone blocks and autologous bone chips.

Three weeks after complete epithelialization of gingiva around the healing abutments, the impression is taken in order to create the prosthetic restorations on the implants. The prosthetic treatment plan included individual, screw-retained metal-ceramic crown (figures 16-19). The first treatment stage included an alginate impression to make the individualized tray. In this case it was created in the dental laboratory, from composite material. The impression abutments were screwed in the implants and with polyether, an open tray impression was used.

After the setting of the impression material, the excess was removed by the aid of a scalpel in order to allow rigid fixation of the impression abutments to the composite tray. For the upper teeth an alginate impression was taken and the bite registration was performed by the aid of a silicone impression material. When inserting the final restoration, the Sheffield test was negative.

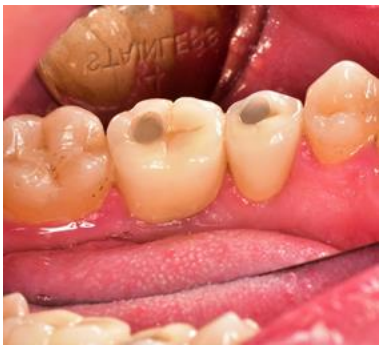

Figure 16. Lingual aspect of the prostethic restorations

Figure 17. Buccal aspect of the prostethic restorations

Figure 18. Occlusal gingival profile

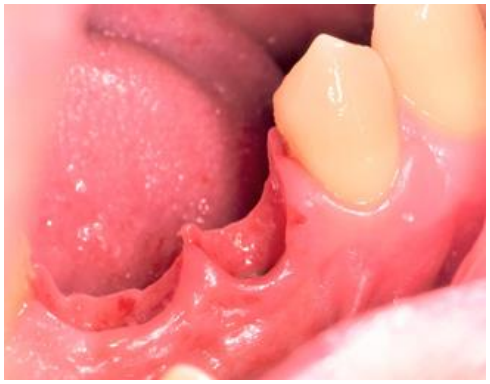

Figure 19. Gingival profile from buccal view

Conclusions

In this case management of fractured implant consists in removing the fractured part and grafting the surgical site for placing a new wider diameter implant later. Bone collected from surgical site was used to its reconstruction.

Conflict of interest: None to declare.

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CASE REPORT

The importance of periodontal plastic surgery as a pre-orthodontic procedure.

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Abstract
The development of new orthodontic appliances has encouraged a growing number of adults to benefit from treatment. The goal of preventive mucogingival surgery is to increase soft tissue coverage before the start of the orthodontic treatment.
The aim of this case report is to present the clinical outcomes of periodontal plastic microsurgery technique as a pre-orthodontic procedure in a 28 years-old female patient with gingival recessions in quadrant II and thin gingival biotype. After a session of prophylaxis and the cervical lesion's treatment, a bilaminar technique with coronally advanced envelope flap was performed. The connective tissue grafts were sutured over the denuded root surfaces with resorbable sutures. The sutures were removed after two weeks postop and the healing was uneventful. The results have been maintained during the orthodontic treatment and no dentin hypersensitivity was reported after the periodontal plastic surgery.
In conclusion, this procedure represents a predictive treatment of recessions and can minimize further recessions and exposure of the roots during the orthodontic forces.
Keywords: periodontics, orthodontics, plastic surgery

Introduction

Although gingival biotype represented by the keratinized tissue and attached gingiva is determined genetically, it may be affected by the presence of plaque-associated inflammation or by the action of certain surgical or mechanical interventions like scaling and root planning.

In the literature, numerous techniques like guided tissue regeneration and guided bone regeneration are presented, but they must be applied according to the type and nature of the periodontal defect.

The aim of this paper is to present the clinical outcomes of periodontal plastic microsurgery technique as a pre-orthodontic procedure.

A number of periodontal plastic procedures to strengthen thin, weak gum tissue and to enhance the appearance of the soft tissues are available. They help maintain the teeth, treat sensitivity, or improve the aesthetics of smile. These include soft tissue grafts and aesthetic crown lengthening procedures.[1]

Adult patients are more and more interested in having orthodontic treatment but many of them have periodontal problems. Periodontal disease can be treated by the patient's general dental practitioner or, if more complex treatment is required, referred to a specialist. Periodontal problems should be addressed prior to orthodontic treatment.[2]

The two primary etiologic factors in the pathogenesis of gingival recessions are periodontal diseases and mechanical trauma. Traumatic tooth brushing appears to be one of the important factors associated with gingival recessions. Other secondary etiologic factors may include bone dehiscences, smoking, intraoral and perioral piercings.[3]

At first, periodontal examination of the affected teeth was performed essentially only clinically without standardized radiographic evidence, thus limiting the identification of the unfavourable sequelae to the clinically detectable signs of gingival recession, with almost no information about the bone levels.[4]

Cone beam computed tomography provides clinically relevant information on this issue, even with its limitations regarding the

overestimation of bone fenestrations and dehiscences.[5-7]

Kahn et al [1] underline that the scientific evidence shows that the subepithelial connective tissue graft promotes higher levels of root coverage, high predictability and provides more gingival thickness.

The development of new orthodontic appliances, that are partially or completely undetectable, has encouraged a growing number of adults to benefit from treatment.

Multi-disciplinary treatments are generally required to obtain a satisfying clinical result that improves aesthetic appearance. The goal of preventive mucogingival surgery is to increase soft tissue coverage before the start of the orthodontic treatment. In fact, treating gingival recessions is more predictable and easier if it is performed before it intensifies [8].

Muco-gingival defects, gingival recession among others occur frequently in adults, have a disposition to increase with age, and occur in populations with standards of oral hygiene that are both high and low. The exposure of the root surface is frequently associated with impaired aesthetics, dentinal hypersensitivity and carious and non-carious cervical lesions.[9]

Depending on the direction of the orthodontic movement, a possibility of gingival recession initiation or progression during or after orthodontic treatment may occur. Several authors have demonstrated that gingival recession may develop during or after orthodontic therapy. The reported prevalence varies from 5% to 12% at the end of treatment. Authors report an increase of the prevalence up to 47% in long-term observation (5 years). However, it has been showed that, when a buccaly positioned tooth is moved in a lingual direction within its alveolar process, the apico-coronal tissue dimension on its buccal aspect will increase in width. A recent systematic review concluded that the direction of the tooth movement and the bucco-lingual thickness of the gingiva play important roles in soft tissue adjustment during orthodontic treatment. There is a higher probability of recession during tooth movement in areas with less than 2 mm of gingiva. Gingival augmentation can be indicated before the start of orthodontic treatment in areas with <2 mm gingival thickness. These conclusions are mainly based on clinical observations and recommendations (low level of evidence).[10-12]

Different factors such as aging, the condition or absence of the interdental periodontal tissue, and especially of the presence of an attached KT band < 2 mm can influence root coverage predictability and explain the lack of stability of the gingival margin in almost half of the treated sites during 20 years of observation.[13,14]

Case presentation

A 28 years-old female patient, was referred by the orthodontist due to the concerning gingival recessions in quadrant II and the thin gingival biotype.

Her chief complaint was the teeth hypersensitivity in the left upper quadrant and the unaesthetic position of the teeth. The patient's medical history revealed no systemic conditions that may contraindicate the plastic periodontal treatment.

Clinical examination showed a Miller class I recession of approximately 3.5 mm for teeth 2.6, 2.5, 2.4 and 0.5 mm for tooth 2.3 (Figure 1). Beside the recessions, the bicuspids (2.4, 2.5) and the molar (2.6) showed cervical non-carious lesions. The overall periodontal examination showed no pathologic probing depths and no bleeding on probing with a plaque score of 8%.

The rationale for improving the periodontal conditions before the orthodontic treatment was to avoid a further and more complicated or untreatable recession.

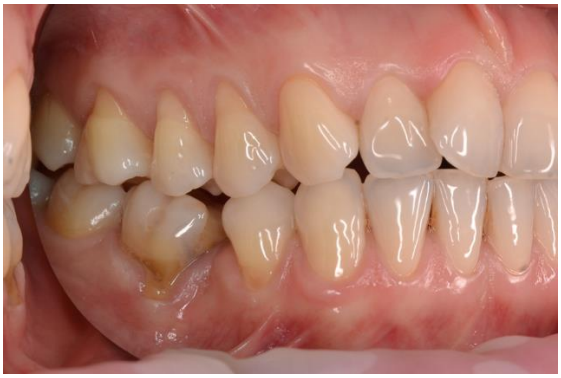

Figure 1. Initial clinical aspect of the recession in quadrant II

Pre-surgical phase

Before performing the plastic periodontal treatment, the main goal was to obtain the

maximum root coverage (MRC) of the recessions. The patient received a session of prophylaxis to remove microbial deposits with ultrasonic scaling, rubber cup, polishing paste and airflow, including oral hygiene instructions on using a coronally directed roll technique to minimize toothbrushing trauma to the periodontal soft tissue margin.

After obtaining the MRC, it was decided to treat the cervical non-carious lesions at the exact MRC level (Figure 2).

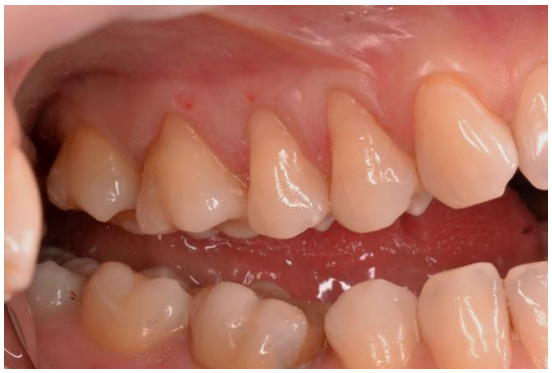

Figure 2. The cervical fillings were placed at the MRC

Surgical phase

At one week after the cervical lesion's treatment, a bilaminar technique with coronally advanced envelope flap was performed.

Following local anesthesia, a split thickness incision was performed extending mesial and distal with one tooth from the recession site, leaving the periosteum attached to the bone (Figures 3, 4). With a microsurgical elevator the periosteum was elevated 3-5 mm on the buccal aspect of the receding teeth (Figure 5).

After elevating the entire flap, root debridement was performed using manual Gracey curettes and EDTA gel 24% was applied for 2 minutes. The remaining facial portion for the anatomical papillae was de-epithelized to create connective tissue beds to which the surgical papillae of the coronally advanced buccal flap were secured during suturing.

A free subepithelial connective tissue graft of 22 mm in lenght, 5 mm in witdh and 1.5 mm in thickness was harvested from the palate. The graft was de-epithelized using a 15C blade and diveded into three sections. The connective tissue grafts were sutured over the denuded root surfaces with resorbable sutures (Figure 6).

The flap was secured with double loop sutures and double vertical and horizontal matress sutures were performed in the buccal fornix (Figure 7). The sutures were removed after two weeks postop and the healing was uneventful.

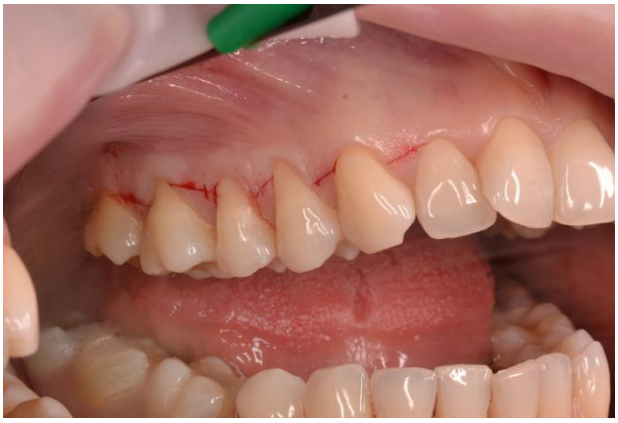

Figure 3. Design of the coronally advance envelope flap

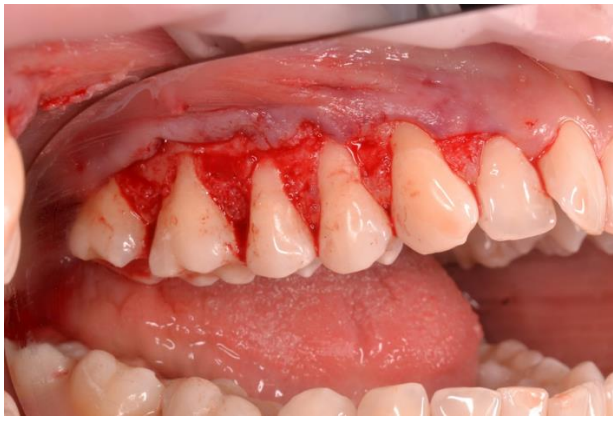

Figure 4. Split thickness flap leaving the periosteum attached to the bone and de-epithelization of the anatomical papillae.

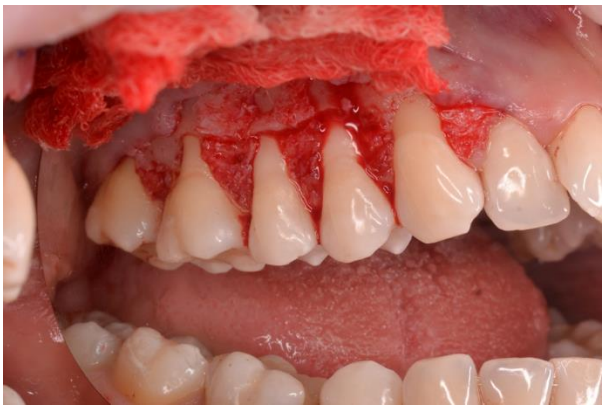

Figure 5. Periosteum elevation of the buccal aspect of the receding teeth

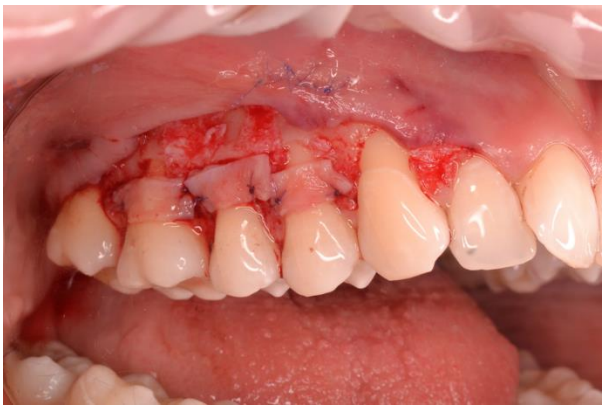

Figure 6. The three sections of connective tissue graft sutured to the periosteum

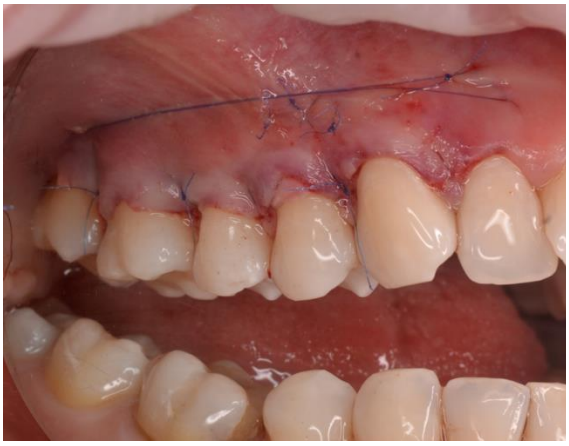

Figure 7. Double vertical and horizontal mattress suture in the buccal fornix

Post-surgical phase

Two weeks later, the sutures were removed. Patient was instructed not to brush in the treated area, only to rinse for 1 minute with an alcohol and chlorhexidine free mouthwash. After suture removal, plaque control was performed by the periodontal plastic surgeon with rotary brushes and polishing paste at low rotating speed (1500 – 2000 rpm). The patient was instructed in mechanical tooth cleaning using an ultrasoft toothbrush for 1 month and told to rinse with alcohol and chlorhexidine free mouthwash twice a day.

At three months postoperative, the patient was referred back to the orthodontist to begin the orthodontic treatment.

Patient was recalled for prophylaxis at 1 month, 3 months, 6 months (Figure 8) and at 1 year postoperative (Figure 9).

The clinical outcomes of this case report showed a complete root coverage, thick gingival biotype, which has been maintained during the orthodontic treatment despite the buccal orthodontic forces for more than one year. No dentin hypersensitivity was reported after the periodontal plastic surgery.

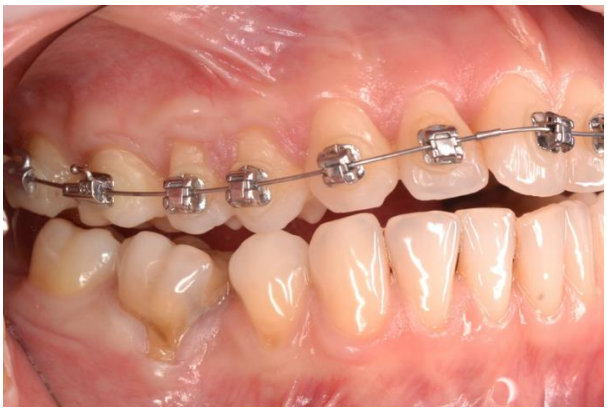

Figure 8. Clinical aspect at 6 months postop

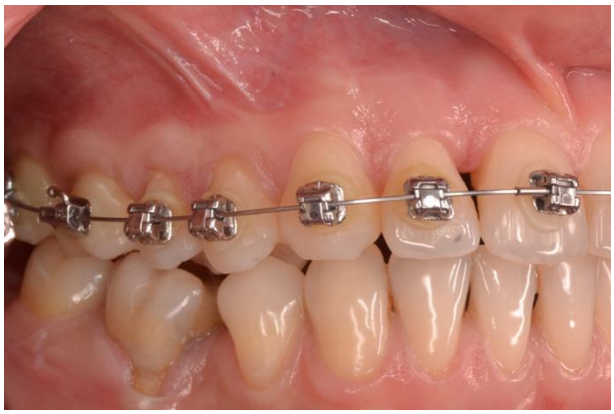

Figure 9. Clinical aspect at 1 year postop.

Discussions

An accurate periodontal diagnosis can be formed only after an accurate and reproducible clinical examination of the periodontium. The results of this examination will lead to either initiating orthodontic treatment or to a two-step process of corrective therapy, prior to orthodontic treatment. A thickening procedure

of the mucosa and a gingival graft must be performed before the orthodontic treatment can begin.[8]

Contradictory results were found regarding a possible statistically significant correlation between the amount of incisor proclination and the extent of gingival recession during treatment, width of attached gingiva, periodontal condition, thickness of the symphysis and hygiene.[4]

Several parameters that influence the results, such as interproximal attachment loss, recession size, dimension of the papilla and flap thickness, have also been identified.

It can be anticipated that if the gingival margin maintains an appropriate thickness after orthodontic treatment, the tissue would be more resistant and less affected by tension from excessive proclination.

Despite the clinical experience that soft tissue augmentation of bucco-lingual gingival dimensions before orthodontic treatment may be a clinically viable treatment option in patients considered at risk, this treatment approach is not based on solid scientific evidence.[15]

There are no high significance animal or clinical studies on this topic. Movement of the incisors out of the osseous envelope of the alveolar process may be associated with a higher tendency for developing gingival recessions, consequently, the risk for developing gingival recession could be significantly reduced.[16]

Conclusions

When dealing with patients that require orthodontic treatments with the presence of gingival recessions and thin biotype, periodontal plastic surgery represents a mandatory pre-orthodontic procedure. This procedure represents a predictive treatment of recessions and can minimize further recessions and exposure of the roots during the orthodontic forces.

Conflict of interest: None to declare.

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CASE REPORT

Comparative aspects in manufacturing the metal framework of RPD. Case management

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Abstract
Removable partial dentures are rarely used due to their complexity and difficult specific clinical and lab steps in the treatment of the patient with class I and II Kennedy edentulism. In the present study through two clinical cases, it was shown that both the clinical and lab steps and the manufacturing cost of these types of prosthetic reconstructions could be reduced. For this purpose, new techniques in manufacturing the wax pattern of the removable part of the RPD have been developed in order to facilitate the lab steps and to gain time. This technique is easier, less time consuming and cheaper than classical techniques, and probably equal in term of precision than other more recent techniques.
Keywords: removable partial denture, framework, wax pattern, acrylic resin pattern.

Introduction

Although class I and II Kennedy partial edentulous arches are often encountered and despite the good outcome of prosthetic treatments trough RPD, this type of denture is not as frequently used as expected, due to its complexity and to the arduous specific clinical and lab steps [1].

At the same time, the manufacturing costs are not to be neglected, even if they are generally lower than those of implant-supported reconstructions [2, 3].

Considering the aspects mentioned above, and keeping in mind the fact that the implant-supported reconstructions also have their limits and contraindications, we can state that lowering the manufacturing costs of RPD's would contribute to the increase of the share of rehabilitation using these devices. Because secondary costs are related to the oral and systemic health consequences of wearing RPDs, a significant need exists to advance the materials and technologies associated with these devices [4, 5, 6].

Case report

Clinical presentation

Two patients were considered for this study. After pro-prosthetic and pre-prosthetic treatment, the class I and II Kennedy edentulous arches were treated using RPD.

One patient latero/lateral-terminal edentulous spaces on the upper jaw and termino-terminal edentulous spaces on the lower jaw (case 1),

7 X X X 3 2 1 I 1 2 3 4 X 6 X – case 1
X X 5 4 3 2 1 I 1 2 3 X X X X

while the second patient had latero/terminal edentulous spaces on the upper jaw.

7 X X X 3 2 1 I 1 2 3 X X X – case 2

Case management

Case 1. Maxillary and class II Kennedy subclass 2 and Kennedy class I mandibular edentulous arches were both treated with RPD anchored with Bredent Vario-Kugel-Snap-SG system.

For the cast metal framework, an alternative lab technique was used that employs an acrylic resin pattern.

Case 2. Mandibular class, I Kennedy edentulous arch was treated with RPD anchored with Rhein 83 attachments, using the classic wax pattern technique and duplicated cast for obtaining the metal framework of the removable part of the reconstruction [7].

Clinical outcome

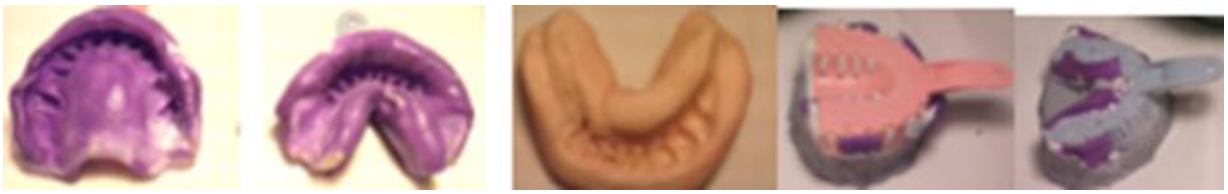

Figure 1. Impressions for working arch, opposing arch and occlusion-case 1; Pouring of the working cast for both arches; Case 1

Figure 2. Master cast with removable dies, detached from the base. E-Light cured trays fabricated for the second impression- case1.

Figure 3. Mandibular (A self-standing joint) and maxillary (C self-standing joint) wax pattern of the copings

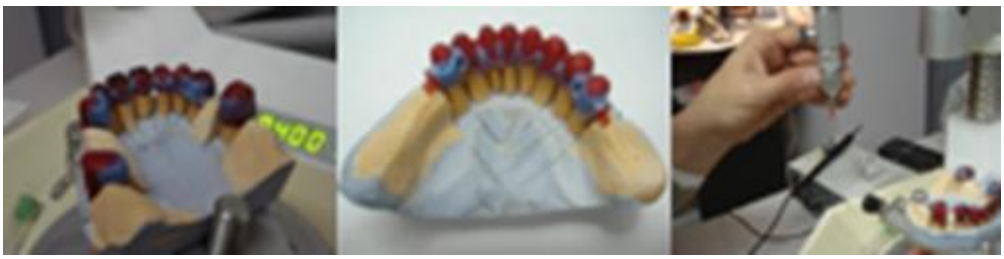

Figure 4. Vario Kugel attached to both wax patterns (upper and lower jaw)-case1

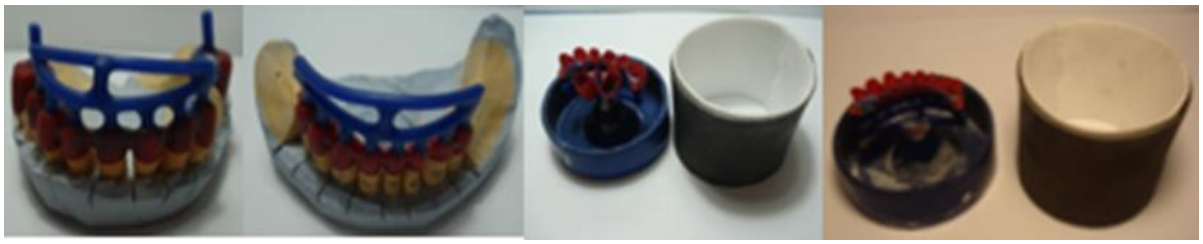

Figure 5. Preparing for investing: spruing and attaching the wax pattern to the sprue former- case1

Figure 6. Preheating, casting and divesting of the fixed part of the RPD- case1.

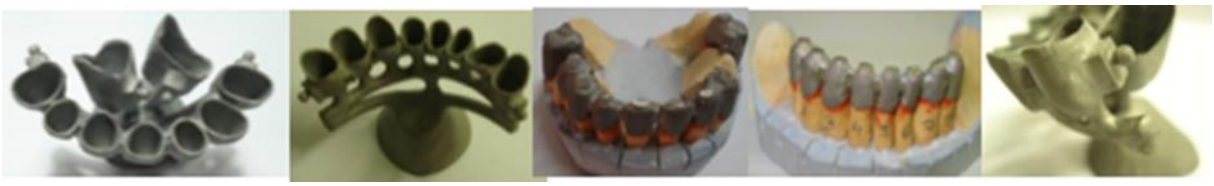

Figure 7. Casted copings for upper and lower arch; framework set on the; detail of the casted attachment.

Figure 8. Drawing on the master cast - limits of the maxillary major connector; master cast with fixed casted framework and retentive clips; Second silicone impressions using the custom trays

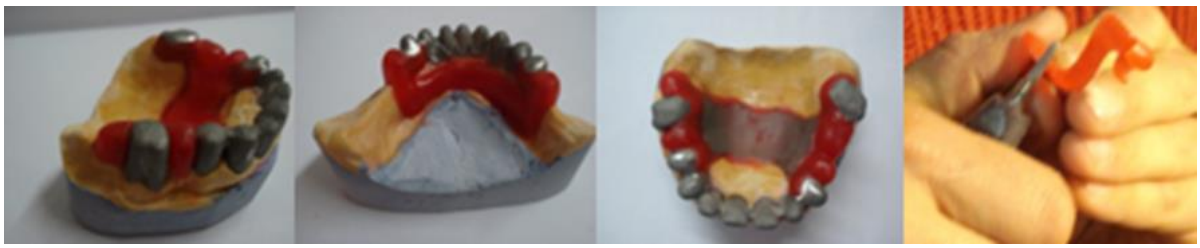

Figure 9. Acrylic pattern fabrication of the removable part of the framework; finishing of the major connector (acrylic pattern)

Figure 10. Spruing of the acrylic pattern of the removable part of the RPD and preparing for investing

Figure 11. Detensioning of the pattern (A); recovering the casted framewor; sandblasting after divesting

Figure 12. Cleaned framework- aspect after sandblasting; detail of the casted attachment

Figure 13. Complete seating on the master cast of the metallic fixed and removable parts of the prosthetic reconstructions

Figure 14. Ceramic layered on the fixed metal framework; Aspect of the removable and fixed parts of the RPD on the master casts

Figure 15. Wax pattern of the saddles with mounted acrylic teeth; finishing of the acrylic component of the RPD); completed RPD on the master cast

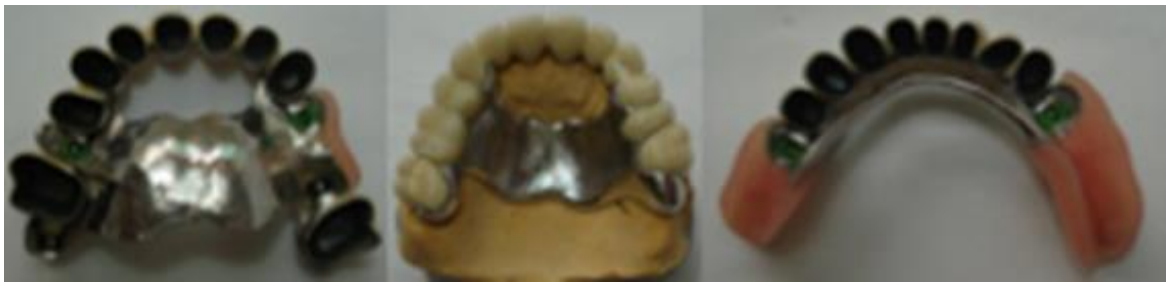

Figure 16. Mucosal and oral aspect of the completed maxillary reconstructions; mucosal aspect of the completed mandibular RPD.

For case 1 (figures 1-16), the impression was taken using putty and fluid PVS.

Class IV plaster (Convertin Hart®) was used for pouring the working cast (with removable dies with Dowel pins) after the impressions were washed and disinfected. The dies were obtained by sectioning the casts. The segments were removed and numbered and then prepared for the wax pattern copings.

The maxillary and mandibular cast were poured the second time, and light cured trays were fabricated on the second poured cast for both arches. A thin wax layer was used as a spacer to provide enough space for the impression material and to ensure a facile detachment of the tray.

Plastic foil technique was used to obtain the wax copings of the FPD, and finally, the copings were joint by means of self-curing acrylic resin, because of its volumetric changes during setting, lower than those of the wax during cooling. A surveyor (Amman®) and 2 ° wax cutter mounted onto the hand-piece were used identify the proximal tooth surfaces to be made parallel to act as guiding planes for placement and removal to establish the perfect

parallelism between the elements of the wax pattern and to set a common insertion path on the required zones were the Bredent® Vario-Kugel-Snap-SG system (case1)/extra-coronal attachments (case 2). With the help of the surveyor and a special device, the attachment systems were carried in place. The male parts were fastened and placed in the right position on the wax pattern, the arm of the surveyor was locked, and with an electric spatula, melted wax was applied to secure the components of the wax pattern.

After all details of the wax patterns of the fixed part of the reconstructions were achieved, sprues were attached, the wax patterns were decreased, and positioned onto the sprue formers while adequate casting rings were selected. Investing, burnout at 950ºC, casting using Biodur® alloy/ and devesting followed. The next step was to apply the working cast to the surveyor's table and to adjust the slider of the opposing arm with a bur having the same 20 tapers as the cutter mounted in the hand-piece used for the wax pattern.

The metal framework of the fixed part of the reconstructions was finished, and try-in in the office followed. The silicone impressions along with the metal framework of the fixed part of the reconstructions were sent at the lab, for proceeding with the technical steps. Extra-hard plaster class IV was used for pouring the working dies on which the wax patterns of the removable parts of the RPD are to be made. After fitting the sliding interlock system onto the male part, the design of the removable part was established, and drawings of the main connector and saddles were made on the working cast.

A thin layer of wax was used for spacing and also for eliminating undercuts between the castable male of the attachments and the edentulous ridge. For case 1 the pattern of the removable part of the RPD is made out of self-curing acrylic seated within the previously drawn limits on the lubricated master cast. The acrylic resin is deposited with a brush, and almost the entire framework is built. More complex elements such as mixed saddles are made out of wax and hardened by applying a thin layer of acrylic resin. A calibrated sheet of wax has been deposited on the oral surface of the main connector to give it a proper texture. The acrylic pattern can be lifted of the working cast, due to its structural strength, and finished using the handpiece and burs.

Onto the areas of the pattern were composite teeth are to be constructed, micro-retention beads are scattered.

The acrylic pattern is then sprued and attached on the sprue former, stress relief is accomplished, and then the pattern is degreased and invested. After burnout, both maxillary and mandibular frameworks were cast using Trillium alloy (Cr-Co alloy, 395 Vickers hardness, 1371ºC melting point), divested and sandblasted for removing of the investment material and the oxide layer.

In order to better appreciate the precision of the casted frameworks after blasting, they were placed over the fixed part (without the retention clips). The remaining vertical distance for achieving the complete insertion was about 1 mm (without forcing). Considering the 2 ° tapering of the bur used at finishing of the fixed part, an+0.04 mm error results in the area of the opposing arm, which represents the porosity of the investment material and a small mismatch between the thermal expansion of the investment material and the shrinkage of the used alloy. After finishing, the removable part was inserted perfectly without having any horizontal mobility.

On the copings of the fixed part of the reconstructions, Vita ceramic material was layered (including the second dentin layer and enamel), while over the removable part, on top of the retentive clips of the attachment, composite resin was layered to obtain the artificial teeth.

On the distal saddles, acrylic artificial teeth were mounted in MI. Retentive clips were also set into the attachments.

Try-in of the wax pattern of the removable part was achieved in the office: static and dynamic occlusion, as well as esthetics and phonetics, were checked.

For case 2 (figures 17-23) PVS was used for the impression of the arch to be reconstructed. Moldano® type III plaster was used for pouring the model on which the copings for the fixed part of the RPD were made, using the dipping technique. With cervical wax, the

marginal fit of the copings was improved, while blue wax was added on the palatal and lingual faces of the copings to create a relatively high oral collar where finishing with help a surveyor (Denshine® JT09) is to be done. Using the surveyor, the attachment was positioned on the proximal faces of the copings, facing the edentulous spaces. Wax patterns were prepared for investing and invested. After the stages of preheating, heating, obtaining the mold, the copings were cast using Heraenium® NA alloy.

The copings were sent for try-in in the office and being set on the abutments, and the custom tray was used for the second impression of the upper arch. The fixed part of the RPD was detached along with the silicone impression material (Elite-Zhermack®) and sent to the lab. After pouring the master cast using extra hard plaster the edentulous spaces, sensitive areas beneath the main connector and areas in contact with the soft tissue was released by using the block out wax.

Duplicating the master cast was done by using a flask and Elite Double 22 duplication silicone (Zhermack®). The X20 Speed (Whip Mix) refractory material was poured into the impression, and the drawing of the removable part was transferred onto the duplicated cast. Hardening procedure of the cast was then followed by wax pattern fabrication (preformed Bego wax pattern parts), including the castable female, spruing, investing, burnout, casting (Heraenium® CE), divesting, finishing of the removable metal framework, try-in on the cast and fitting with the fixed part of the prosthetic reconstruction. The framework was sent to the office for try-in.

After sandblasting with aluminum oxide, sintering for creating the oxide layer, opaque (wash opaque and opaque), dentin, enamel layers were applied onto the copings, using Noritake® ceramic material.

During the try-in in the office, the complete seating of the removable part of the framework onto the fixed part of the reconstruction was checked. Also, aesthetics for the frontal reconstructions was assessed and with the help of the wax rims manufactured in the lab and intermaxillary relationships were established.

When returning in the lab, the wax pattern for the acrylic saddles was modeled out of red wax, and the acrylic teeth were set on the saddle (distal and in the lateral area). Again try-in followed. Intermaxillary relationships were checked for the fixed and removable part, as well as phonetics and aesthetics. The thermo-polymerization of the saddles (Superacryl Plus-Spofa®) were finished and again try-in in the mouth followed. In the end polishing of the acrylic part and final glaze for the fixed reconstruction was achieved.

Figure 17. Impression of the upper arch; working cast of the upper jaw; Wax patterns of the fixed parts of the RPD

Figure 18. Preformed attachments; wax pattern with attachments on the abutments limiting the edentulous space

Figure 19. Metal framework set on the master cast (A, B, C); Surveying (C); aspect of the fixed parts

Figure 20. Metal framework-fixed part on the cast; releasing of the master cast- case 2

Figure 21. Duplication of the master cast; duplicated cast made out of investment material; wax pattern fabrication- classical method; spruing of the wax pattern; casted framework- case 2.

Figure 22. Layering of ceramic material and firing stage; completed fixed part seated together with the removable part on the cast-case 2.

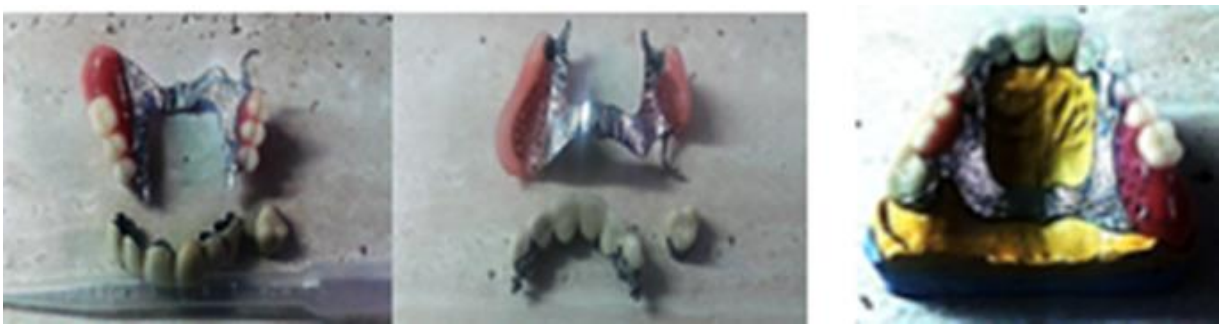

Figure 23. Completed reconstruction off and on the master cast-case 2.

Discussion

New techniques in manufacturing the wax pattern of the removable part of the RPD have been developed in order to facilitate the lab steps and to gain time. The technique mentioned above is easier, less time consuming and cheaper than classical techniques, and probably equal in term of precision than other more recent techniques.

Digital technology (CAD-CAM) and its application to the design and fabrication of a single tooth to a complete-arch prosthesis is advancing rapidly. Computer-aided design and computer-aided manufacturing (CAD-CAM) systems are being widely used in the design and fabrication of fixed, implant, and removable prostheses. After scanning, drawing with a pencil/spatula on the virtual working cast the design future framework is possible, the software being able to replicate the boundaries of the pencil [8, 9]. 3D printing is the final stage for obtaining the framework. The complexity of technical stages in manufacturing RPD increases the difficulty in obtaining faultless reconstructions, is time-consuming and often generates mistakes [10, 11]. That is why we tend to shorten working times or even eliminate intermediate stages. Thus, new materials have appeared on the market, which tends to modify, at least in part, the work style and the technical steps. This category includes materials (self or light curing) used in direct modeling on the model [2].

Conclusions

The wax or acrylic pattern represents the final form of the future cast, made out of materials which can be burnt out completely. The classical technique implies duplicating the master cast, using the same material as for investing. By using these materials, certain intermediate steps are eliminated, thus shortening time and saving materials that are usually not cheap. This technique also has the advantage that the pattern may be somewhat tested on the master cast to predict the behavior of the future casted framework, by assessing its behavior from a static and dynamic point of view.

Conflict of interest: None to declare.

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- only cite references to published methods.
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- specify statistical significance test methods.

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