Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

The effect of multi wall Nano-tube in the toothpaste on the alveolar bone

Raed Fadhil Mohammed

Ministry of health /medical city

Fadlrayd910@gmail.com

Abstract

Nano-scale changes to the surface of the implant may alter the implant surface's reactivity. It is stated that in endosseous implants, particularly during the first stages of bone formation, small bone adhesion occurs. The chemical reactivity of most materials appears to change nanoscale changes. Ellingsen has demonstrated the drastic modification of titanium precipitation with sandblasted calcium phosphate by surface treatment with hydrofluoric acid (HF), which provides nanotopography-like surfaces. When a pull-off test tested the physical contact of these titanium discs with the bone, adhesion of the bone to the HF-treated titanium surface was obvious.

And molecular (non-cellular), contact with the tissues harbour bio-mimetic characteristics of the nanoscale modifications of endosteal tissues at implantation interface. Davies defined solid surfaces bone/implant formation as a four-stage process, including non-collagene bone adsorption from proteins to the solid surface[i]. The crucial method is the mineralization of the incipient surfaces with the adsorption of protein. In a recent study by Mendes etcoll., it concludes that the surface is not bound to have a sub-micron complexity on which the cement matrix line can be deposited and interacting with conventional "bioactive" lithomorphic materials like CaP and bioactive glass. Nanoscale topography could provide biomimetic surfaces which permit mineral hydroxyapatite formation and guide bone mineralization in organic phases.

The creation of an implant/bone interface can be based on topographical parameters both in nanoscale and micro-scale. The position of the surface parameters (chemical and topographical) must consider molecular (ionic and biomollecular) interactions with the surface, the cell adhesion phenomena and the locally defined biomechanical characteristics. It is clear that improvements to nanoscale affect the chemical reactivity and modify ion and biomolecular interactions with the surface of the endosteal implant. Improved wetting, deficient protein adsorption and mineralization phenomena are suggested improvements. Protein wetting and adsorption modifications contribute to cell adhesion compromised and are likely to include both integrin and non-integrin receptors. In implant therapy to improve

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

stability, the potential for minerazation and epitapic crystal growth can change the biomechanical environment.

Introduction

This type of surface treatment consists of heterogeneous precipitation of calcium phosphate under physiological conditions of temperature and pH on the dental implant, through the use of ions solution similar to blood plasma with a view to depositing the apatite layer. Once the molecules are integrated into the material's structure, they are gradually released, thus being able to increase osseoconductivity and potentiate the formation of bone around the implant. Calcium phosphate today presents itself as one of the main biomaterials for bone tissue replacement and regeneration, as it has the following characteristics: similarity with the mineral phase of bone tissue, teeth and calcified tissues; excellent biocompatibility; bioactivity; absence of toxicity; variable degradation rates; osteoconductivity. Another advantage of this surface treatment is that biologically active molecules, such as osteogenic agents, can be precipitated as inorganic components to form a matrix with both osteoinductive (growth factors) and osteoconductive (calcium phosphate layer) properties (1) (2).

Nanotechnology applied to health has been a great advance in the field of medicine. Thanks to techniques that operate on a Nano metric scale, it is possible to apply less invasive therapies, achieve earlier prevention and faster cures. Given its advantages, Nano medicine has already spread to the field of Dentistry, where complex and precision work is frequently performed that requires compression of the microstructures that form the teeth and colonizing microorganisms (3). Nano-dentistry has provided new technologies in the development of innovative materials with particles in the nanometric ranges, and their daily clinical application such as nano-particles, nanotubes and nanorobots, which have improved even traditional procedures, revolutionizing classical dental procedures and therapies. In recent years, many companies have already begun to market their nano-hybrid resins, nano fillers and nano adhesives. The development of nano-dentistry is applied in the three-dimensional reconstruction of images with the acquisition of physiological data, design of flexible instruments capable of developing cranial and facial sutures, excision of oral tumors without the need for surgical incision and production of nanochips and magnetic implants with remote control (4). Contemporary dentistry presents important challenges, among which is the need for intense research to offer therapeutic solutions to numerous dental ailments that

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

afflict the population, such as: dental caries, periodontal disease, malocclusion, tumors, trauma and dental fractures, among others. All these conditions are a consequence of the progressive growth of the world population due to the current demographic phenomena. This leads to the mandatory prescription of very expensive and impossible treatments, at least for a majority population in countries with an emerging economy (5). Therefore, it is projected that by the year 2025, a high demand for dental care will become a serious public health problem. The answers to these health challenges will be vigorously linked to the conjunction, application, organization and development of new foundations between nano-scale technology and dentistry. These precepts will be the basis for the future development of new treatments and the foundation of a new scientific modality, "nano-dentistry". For researchers and oral health professionals, in this nanotechnological microcosm a range of possibilities opens up, mysterious and at the same time challenging, allowing an in-depth exploration of a sector of technological development that until now remained in the dark and that could revolutionize and change the scientific-academic world of dentistry (6).

Materials and Methods

The present study consisted of rehabilitation with oral implants in patients with some degree of dental loss, unit, partial or total. The patients treated with threaded implants with a sandblasted and etched titanium surface with a nanometric structure, and early functional loading protocols were applied after insertion, at 6 weeks in the mandible and 8 weeks in the maxilla.

The present study those patients with some degree of dental loss that did not include the performance of the more complex implant surgical procedures (such as, for example, tissue regeneration, bone grafts, growth factors).

Prosthetics

The functional loading of the implants according to an established implant protocol of early loading after insertion at 6 weeks in the mandible and 8 weeks in the maxilla. The elapsed time of clinical follow-up from the functional load of all implants was at least 18 months).

Single crowns

In patients with unitary dental losses in the posterior sector, no provisional removable unitary prosthesis performed. Edentulous patients with unitary tooth losses in the anterior sector underwent remodeling of their removable unitary prosthesis so that it did not occlusally affect

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

the inserted implant until the implant-supported prosthodontic procedure was performed. 6 weeks in the lower jaw and 8 weeks weeks in the upper jaw, after insertion of the implants, the early functional loading of the implants was performed by placing a single crown.

For this it is possible to combine punctual and linear osteotomy lines circumscribing the roots. Some authors recommend staying 2 to 3 mm below the alveolar ridge.

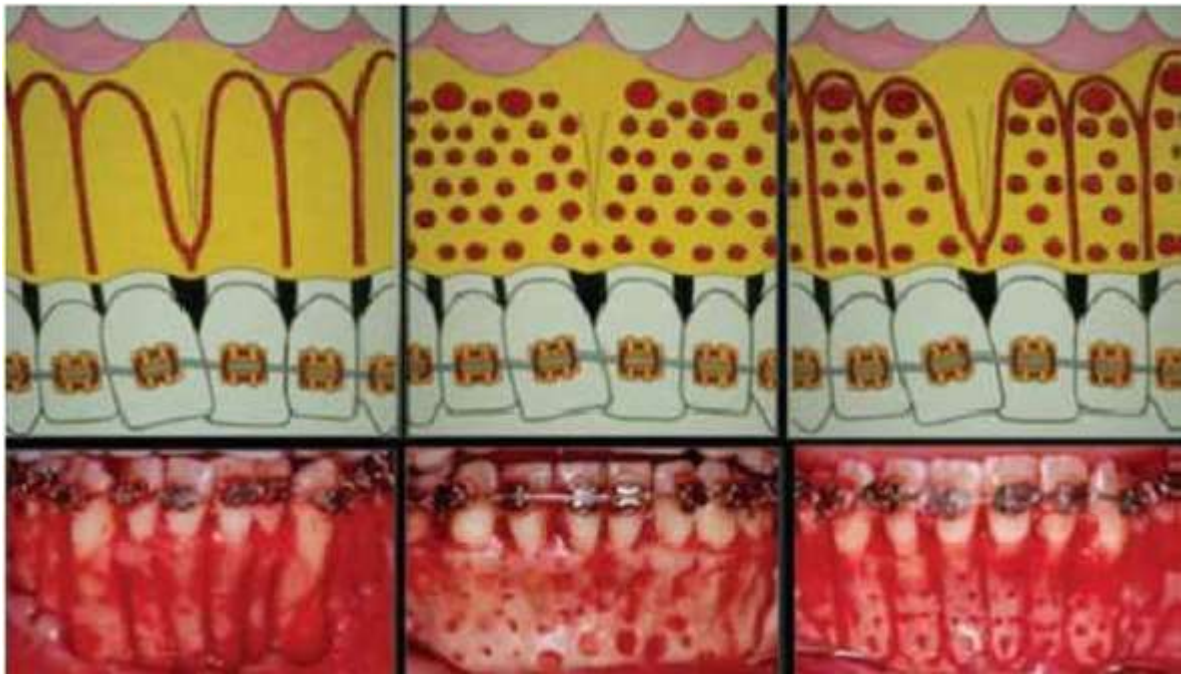

Figure 1 : Several decortication schemes are possible (lines, points), the goal being to injure the cortical bone.

Use a bone bur mounted on a handpiece at high speed and under abundant irrigation to perform osteotomy lines, while (7) use a diamond circular saw (Komet®) and an oscillating reciprocating saw (Braun Aesculap). Alveolar decortication is performed only on the teeth to be moved orthodontically, which reinforces the anchorage of the teeth not undergoing corticotomy.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

Figure 2: Conventional alveolar corticotomy. Cortical incisions are made with a bone bur after elevation of a mucoperiosteal flap vestibular and palatal

Location of the Implants

Of the 364 implants inserted, 224 were inserted in the upper jaw and 140 in the mandible (Table 1). Of the 364 implants inserted, 118 implants were inserted in the anterior sector (incisors and canines), 48 maxillary implants and 70 mandibular implants. implants were inserted in the posterior sector (premolars and molars), 176 maxillary and 70 mandibular (Table 1).

Table 1: DISTRIBUTION OF IMPLANTS ACCORDING TO THEIR LOCATION

LOCATION	Anterior	Posterior	Total
MAXILLARY	48 (13.2%)	176 (48.3%)	224 (61.5)
MANDIBLE	70 (19.2%)	70 (19.2%)	140 (38.5%)
TOTAL	118 (32.4)	246 (67.5%)	364 (100%)

Prosthesis on Implants

All patients treated with implants were rehabilitated using an early functional loading protocol, with their corresponding prostheses after a period of 6 weeks in the mandible and 8 weeks in the upper jaw.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

United Crowns

71 patients (42.3%) were rehabilitated with single crowns over the inserted dental implants (Table 1) (Figures 1-2).

Figure 1

Figure 2

Fixed Prosthesis

60 patients (35.7%) were rehabilitated with fixed bridges over the inserted dental implants (Table 1) (Figures 3 and 4).

Figure 3

Figure 4

Over dentures

37 patients (22%) were rehabilitated with overdentures over the inserted dental implants (Table 2) (Figures 4-5).

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

Figure 4

Figure 5

Table 2: PROSTHESIS AND CLINICAL FOLLOW-UP OF PATIENTS

PROSTHESIS	Crown	Fixed bridge	Overdenture	Total
	71 (42.3%)	60 (35.7%)	37 (22%)	168 (100%)
TRACING	<20 months	20-30 months	> 30 months	Total
	50 (29.8%)	71 (42.2%)	47 (28%)	168 (100%)

Complication

In 17 patients (10.1%) there were complications. 12 patients (7.1%) presented some degree of inflammation or pain after insertion of the implants. In 3 patients (1.8%) there was mandibular paresthesia. In 2 patients (1.2%) there was dishesion of the surgical wound.

Failures Loss of Implants

23 implants (6.3%) of the 364 inserted implants were lost in the early phase of treatment before functional loading with the corresponding prosthesis. No implants have subsequently been lost. In 6 implants (1.6%) there was peri-implantitis, none were lost. There were no significant differences when relating the loss of implants with the demographic variables, age (Kruskall-Wallis test, $p = 0.2862$), and sex (Mann-Whitney U test, $p = 0.2452$). There were no significant differences when relating the loss of implants with the clinical variables,

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

smoking (Mann-Whitney U test, p = 0.7042), and medical history (Mann-Whitney U test, p = 0.2994) .

There were no significant differences when relating the loss of implants with the implant variables, implant diameter (Mann-Whitney U test, p = 0.2759), and implant length (Mann-Whitney U test, p = 0, 1427).

Clinical Follow-up

The mean follow-up of the implant treatments in the patients studied was 34.3 months with a range between 18-47 months (Table 2).

50 patients (29.8%) were followed for a mean time of up to 26 months; 71 patients (42.2%) were followed for a mean time between 26 and 36 months, while 47 patients (28%) were followed for a mean time greater than 36 months. There were significant differences according to the chi-square test (p = 0, 00038) (Table 2).

Associated registry

Some authors (8) recommend the apposition of bone grafts at corticotomy in order to increase bone volume in areas with a high risk of root dehiscence or fenestration, especially when a significant transverse expansion is expected. However, the increase obtained is limited.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

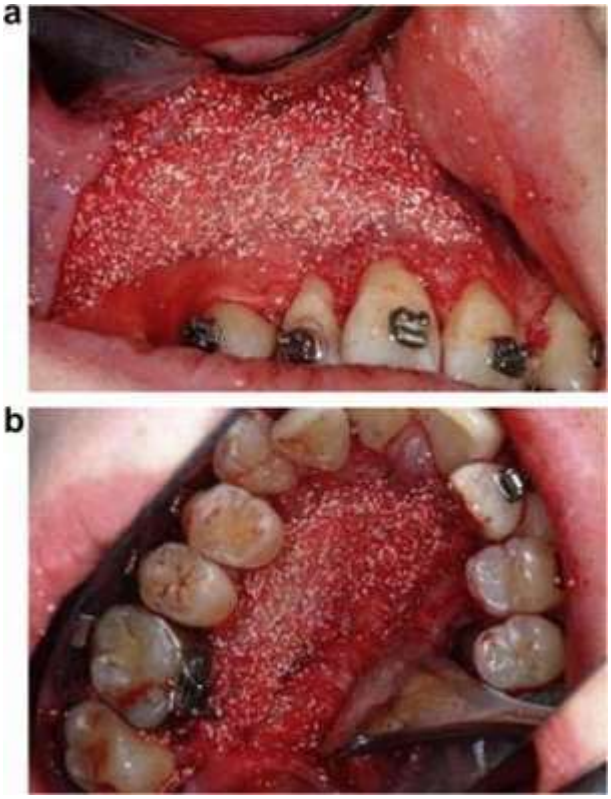

Figure 3: Bone graft associated with corticotomy (DFDBA allograft and Osteograft® bovine xenograft) (9)

Figure 4: Increase in bone volume following corticomy associated with bone grafting. A marked increase in vestibular bone volume can be observed "post-treatment" (10)

In a clinical and radiographic study carried out in ten patients with extruded incisors and advanced periodontal disease, and on the other hand Re et al 40 in a case report, showed that with the combination of periodontal and orthodontic treatment, it is possible bone filling of

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

the defect, periodontal insertion gain and reduction of sac depth and gingival recession. The combined therapy consisted of firstly submitting the patients to periodontal surgery, for debridement of the tooth surface and removal of granulation tissue, with the onset of BM at seven days and continuous periodontal monitoring. This movement was developed with light and continuous forces of 10 to 15 grams to close the formed diastema, and in an apical direction to intrude the tooth. The orthodontic treatment was developed in a period of at least ten months, and at the end of it, the patients received direct retention (13) (Figure 5 , 6)

Figure 5. A: Initial anterior view. B: Appearance of bone defect during surgical procedure. C: Apparatus for intrusion and OM towards periodontal defect.

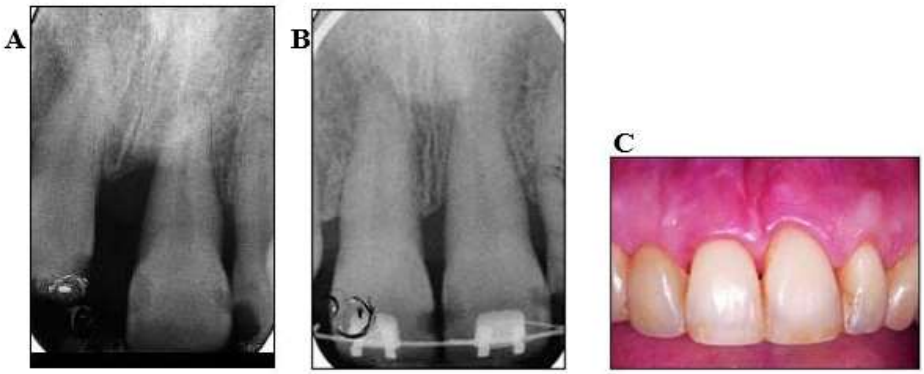

Figure 6. A: Initial radiograph. B: Final X-ray. C: Final clinical view of the treatment.

Interests of Piezocision

The Piezocision technique clinically presents results similar to those obtained after conventional corticotomy with the advantages of being shorter to perform, minimally invasive and significantly less traumatic for the patient. Clinically, the reduction in treatment time is equivalent to that obtained by conventional corticotomy.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

From a technical standpoint, forty-five minutes to one hour are sufficient for a complete maxillary and mandibular intervention with graft against three to four hours for conventional techniques.

Moreover, if the traditional methods could be associated with certain periodontal complications, it seems that the fact of not raising a flap in the minimally invasive technique eliminates these risks. In addition, corticotomy is performed only vestibularly. There is a preservation of the taste buds greatly limiting the risk of recession (11).

Finally, the postoperative post-piezocision is much lighter and allows a return to normal activities quickly after the operation. Operative pain is generally minimal and well tolerated by the patient (12).

Figure 7: Corticotomy performed at site 22 (13)

Disadvantages and limitations of the technique

Due to the absence of elevation of mucoperiosteal flaps, cortical incisions may present a risk of root damage, especially in close proximity. A risk also exists at the level of the mental foramina. A panoramic X-ray as well as retro-alveolar views of the risk areas are therefore essential for preparing for the operation. The contribution of three-dimensional imaging will compensate for the lack of direct vision of bone structures.

An additional precaution is also required regarding the location of the gingival incisions. It is very important to stay at least 2 mm from the marginal gingiva in order to avoid the formation of scarring.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

In case of gingival pigmentations of ethnic origin, the piezocision technique can create an aesthetic problem. Indeed, each incision is likely to leave a trace that will not re-pigment, leaving scars and aesthetic damage in patients with excessive gingival exposure. These patients should therefore be warned of the potential risk of postoperative scarring (14).

Surgical technique

The treatment plan must be established on the basis of a classic orthodontic examination (clinical examination, models, photographs, additional radiological examinations). The use of corticotomies in no way changes the importance given to the diagnosis.

During a second appointment, the patient receives an explanation of the chronology and the different stages of treatment. It is essential to stress from the outset the importance of activating orthodontic devices every two weeks, to maintain the mechanical stress on the alveolar bone. If the patient does not have sufficient motivation to stick to this schedule, alternative treatment plans should be preferred.

Orthodontic treatment, with or without corticotomy assistance, should be performed on a periodontium which is sometimes reduced but perfectly healthy. The orthodontist determines the movements to be considered and the teeth serving as anchors. Sectors not affected by surgery will have greater anchoring capacities. The orthodontist prescribes the performance of corticotomies in specific areas. It is also necessary to take into account the aesthetic and periodontal requirements that may modify the intervention: for example, if a patient presents with gingival recession in an area requiring corticotomies, a gum plasty should be associated. Likewise, a bone graft should be performed if there is a risk or proven presence of fenestration. If the two arches do not have the same degree of correction, corticotomies can be performed on one and not the other while correcting both arches at the same time. Regardless of the surgical technique used, the examinations necessary to ensure the safety of structures adjacent to the operation must be performed (15) (retroalveolar assessment, scanner, cone beam).

Mechanical devices are placed following orthodontic and periodontic consultations. The surgery is performed one to two weeks after fitting the appliance. This delay makes it possible to obtain an initiation of osteoclastic activity by mechanical stimulation in the region where the surgery will be performed: this is called orthodontic pre-activation.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

The surgery is performed under local anesthesia. Vertical gingival incisions are made below the interdental papilla using a number 15 blade and held as much as possible in the attached gingiva (Figure 6a). These incisions do not need to be extended (micro-incisions), but must nevertheless pass through the periosteum, thus allowing the blade to come into contact with the alveolar bone.

Ultrasonic instrumentation (Figure 6b) is then used to perform the corticotomy lines through the gingival micro-incisions and to a depth of 3 mm on average, corresponding to the thickness of the bone cortex (Figure 6c). Note that no suturing is necessary except in areas where a bone graft is placed (16).

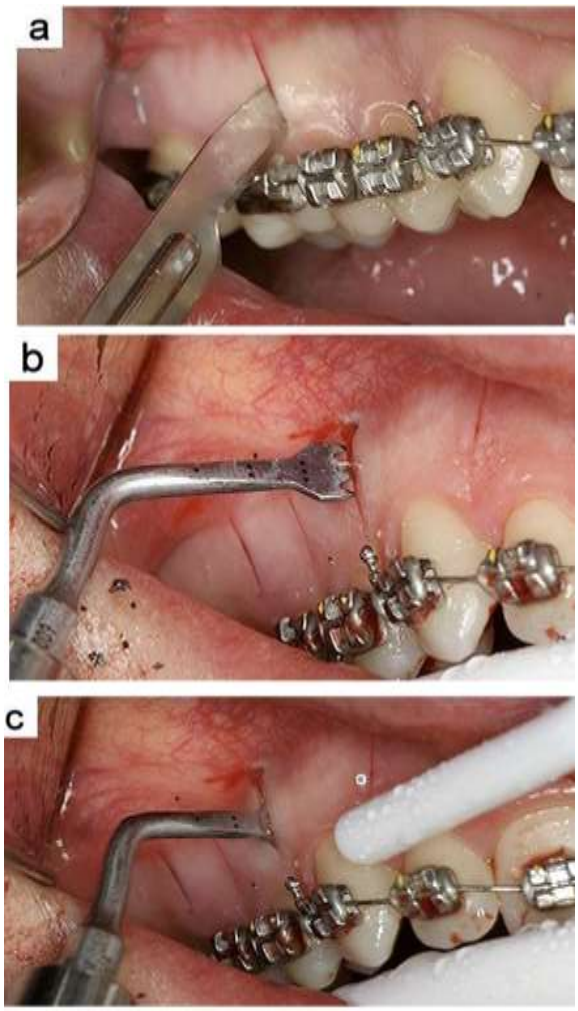

Figure 8: Performing a corticotomy by Piezocision (a: making the incisions / b and c: performing the Piezocision) (17)

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

Post-operative follow-up

At the end of the operation, the patient is placed on antibiotics, non-steroidal anti-inflammatory drugs or paracetamol and chlorhexidine-based mouthwashes (0.12%). Brushing of the surgical sites should be avoided during the first postoperative week in order to allow smooth gingival healing.

Figure 9: Healing at one week: the postoperative effects are minimal (18).

Results and Discussion

A 26-year-old patient consults because she finds her smile "unsightly". For professional reasons, she wishes to opt for accelerated orthodontic treatment. When smiling, the patient exposes 100% of the incisors and 1 to 2 mm of gensiva. The mandibular dental midline is at m, to the right of the maxilla and dental median of the face. The arches have a U-shape, with dimensions and rotation. From a dental point of view, it presents a class II type 2. The canines have a class II relationship, 4 mm on the right and 2 mm on the left. The overjet is 3 mm and the overbite is 65% coverage of the lower incisors (19).

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

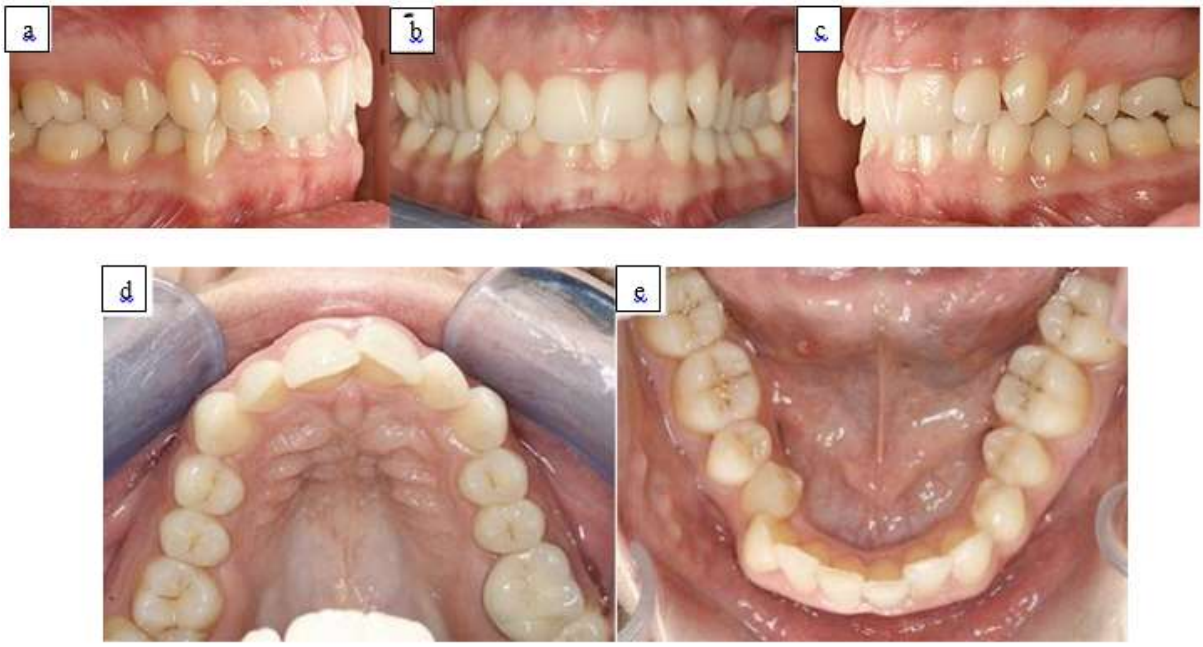

Figure 10: Initial photos (a: right view / b: front view / c: left view / d: maxillary arch / e: mandibular arch).

Therapeutic objectives

The goal of treatment is to align the teeth, open the bite, and establish a class I, patient-friendly relationship with reduced treatment time. The patient was offered a classic treatment, as well as a more innovative one combining orthodontic care with periodontal piezocision surgery. An associated bone graft is planned at the level of the mandibular symphysis, where expansion is needed, to expand the bone envelope and increase periodontal support to improve long-term stability and decrease recurrence (20).

As the patient wanted a short treatment, orthodontic treatment coupled with piezocision was chosen.

Surgical technique

Surgery is performed one week after placement of the orthodontic appliance.

Ten vertical interproximal incisions are made on the buccal surface. They are minimal except in areas of bone grafts (classically, between the canines and the lateral ones, and between the central ones). The incisions are full thickness which allows the blade to reach the alveolar bone. A piezo-scalpel (BS 1 insert, Piezotome, Satelec Acteon Group, Mérignac France) is then used to create the alveolar cortical incision through the microgingival openings to a depth of 3 mm (21).

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

Figure 11: Performing corticotomy by Piezocision.

A bone graft is done in the symphyseal area where there is little vestibular bone. This location is tunneled to accommodate the transplant. The incisions are closed with biological medical glue based on cyanoacrylate.

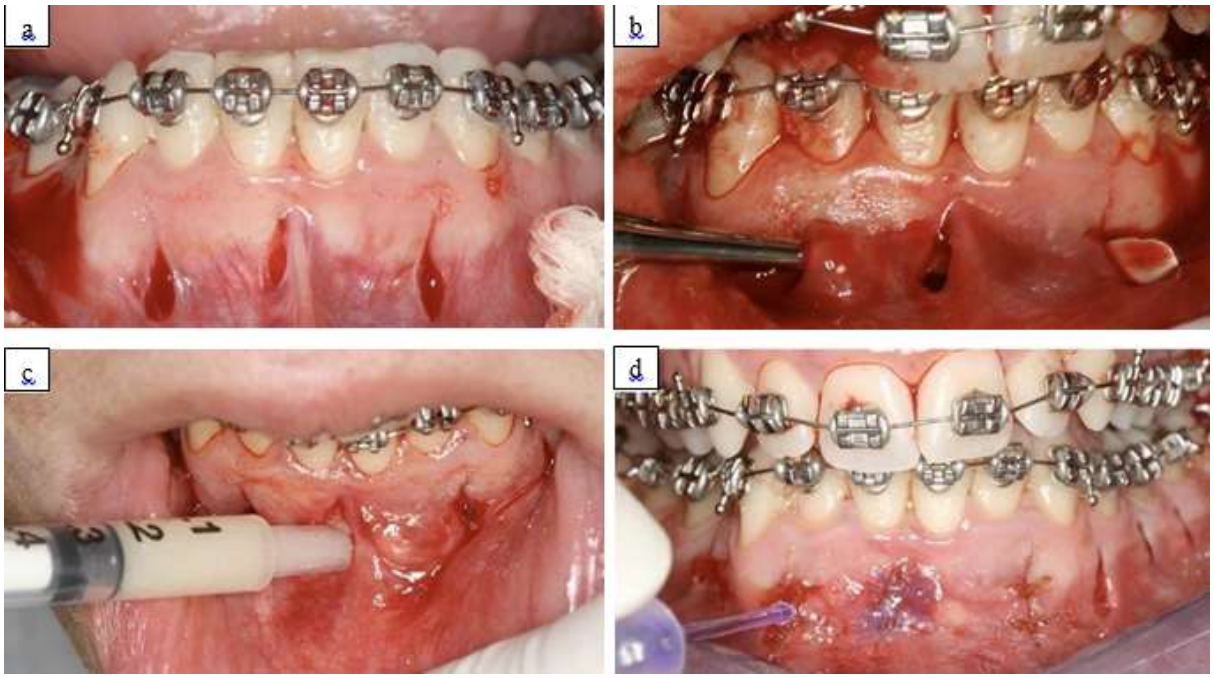

Figure 12: Performing the bone graft (a: vertical incisions / b: tunneling / c: placement of the graft material / d: closure of the graft site with cyanoacrylate-based medical biological glue)

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

The patient was sent home with a prescription for antibiotics and anti-inflammatory drugs after having received classic post-operative advice (put on ice, do not smoke, do not eat hot ...).

Treatment progression

The patient only took two NSAID tablets after the surgery. No follow-up has been reported. The patient was able to resume oral function twenty-four hours after surgery. Periodontal healing is optimal at two weeks. It is of paramount importance for the orthodontist and the surgeon to understand that the turnover, induced by surgery, is limited to the proximity of the surgical cuts. Special attention should be given to bone incisions which should be made only around teeth where tooth movement is expected. As such, the value of the anchoring of teeth, outside the surgical site, remains high while the anchoring value of adjacent teeth is low (22). PAR is transient, but mechanical stimulation of the teeth prolongs the effect of osteopenia. Therefore, it is imperative to adjust the orthodontic appliance every two weeks. During treatment, a sharp increase in tooth mobility is observed, resulting in transient osteopenia. It is also important to note that greater forces are applied to the teeth, compared to conventional treatment, to maintain the mechanical stimulation of the alveolar bone and the osteopenic state allowing for rapid treatment (23).

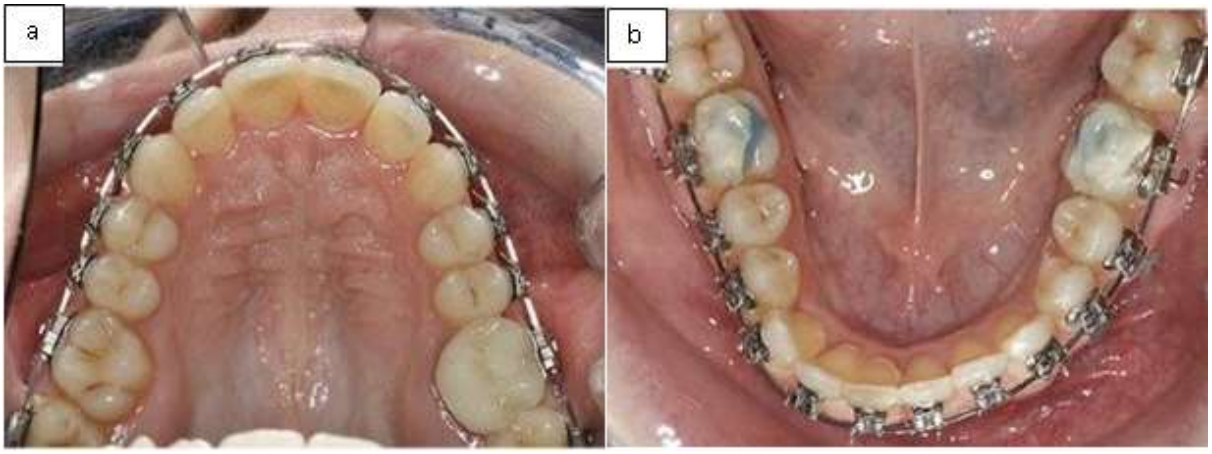

Figure 13: Treatment progression (a: maxillary arch / b: mandibular arch)

Treatment results

After 4 months of active treatment, the patient is flushed out and a maxillary and mandibular lingual retention is inserted, from canine to canine. The dental arches are fully aligned, a Class I relationship is achieved on both sides, the overjet is reduced to an ideal of 1mm, and the overbite is improved, initially 65% coverage to 8%, after treatment (24).

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

Figure 14: Clinical situation at the end of treatment (a: right view / b: front view / c: left view / d: maxillary arch / e: mandibular arch).

A 31-year-old patient consults because she presents a strong dental crowding leading to an unsightly smile. The extraoral examination shows facial symmetry as well as a good proportion of the vertical layers of the face. In soft tissues, the patient presents good facial harmony. On intraoral examination, the patient presented no cavities or periodontal problems. When smiling, the patient exposes 90% of the incisors. The inter-incisor line is deviated 2 mm to the right of the mid-sagittal plane. The arches are U-shaped, with encumbrances of 8 mm in the maxilla and 4-5 mm in the mandible. Canine n ° 13 is in the vestibular position, there is only 2 mm of space between the distal part of the lateral incisor n ° 12 and the mesial zone of the premolar n ° 14. From the dental point of view, it has a class II type 2. The overjet is 3 mm and the overbit is 30% coverage of the lower incisors. For professional reasons, she wishes to opt for accelerated orthodontic treatment (25).

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

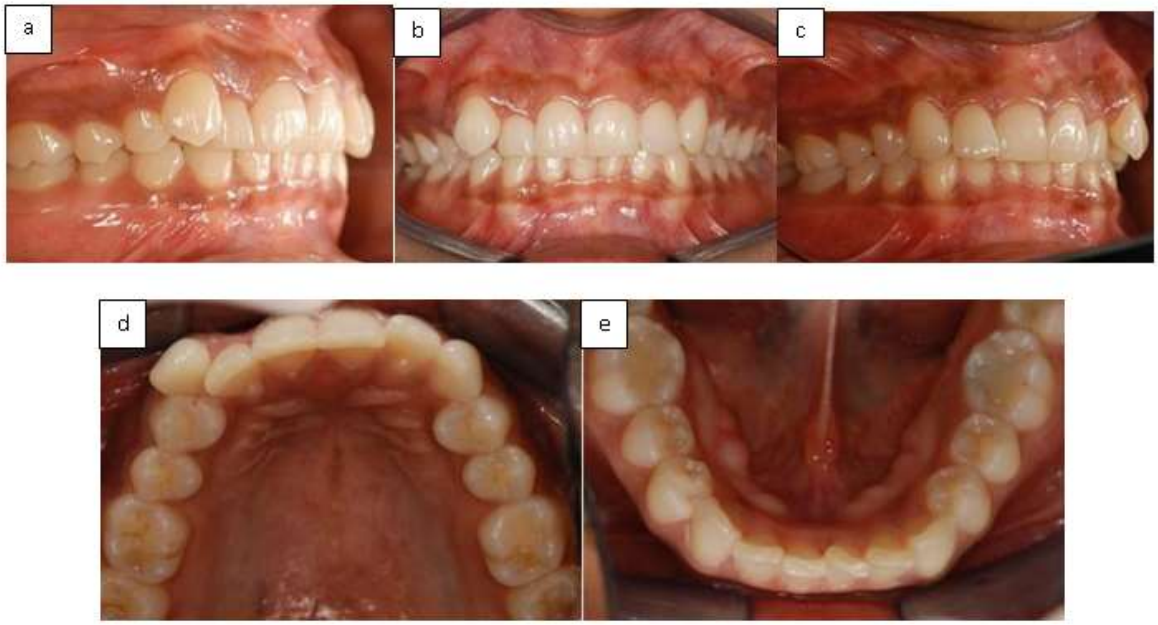

Figure 15: Initial photos (a: right view / b: front view / c: left view / d: maxillary arch / e: mandibular arch)

Therapeutic objectives

The goal of treatment is to align teeth, restore function and aesthetics, remove crowding, open occlusion and establish a class I relationship with alignment of the interincisor line and the median sagittal plane. The patient was offered a classic treatment with avulsions of the first premolars, as well as a more innovative one combining orthodontic care with periodontal piezocision surgery without avulsions. Combined bone grafting is planned for areas where expansion is needed to expand the bone envelope and increase periodontal support to improve long-term stability and decrease recurrence (26).

As the patient wanted a short treatment, orthodontic treatment coupled with piezocision was chosen.

Treatment results

After eight months of active treatment, the patient is flushed out and a maxillary and mandibular lingual retention is inserted, from canine to canine. The dental arches are fully leveled and aligned. A two-sided class I relationship is achieved, the initial 3mm overjet is reduced to an ideal of 1mm, and the overbite is improved, initially 30% recovery to 15% after treatment (27).

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

Figure 16: Clinical situation at the end of treatment (a: right view / b: front view / c: left view / d: maxillary arch / e: mandibular arch)

Conclusion

Even though good clinical results are obtained with conventional corticotomies, the invasive aspect of this surgery has never allowed its development. Thus, some authors have sought to develop another surgical technique making it possible to obtain the same clinical results by very significantly reducing the invasive side of the intervention: Piezocision.

The objective of this work is to conduct a study of the literature in order, on the one hand, to describe the different operative techniques for performing a corticomy, more particularly developing the piezocision technique. On the other hand, we will study the biological effects of corticomy on the bone tissue allowing this acceleration of dental movements. Finally, we will illustrate this work by presenting two clinical cases.

We have shown that alveolar corticotomy by piezocision is a reliable, reproducible and minimally invasive technique. Thanks to the "regional acceleration phenomenon", initially described by Frost, it causes a transient decrease in bone density resulting in a localized area of less resistance. This phenomenon thus significantly accelerates tooth movement.

However, this technique is currently offered very little by orthodontists, either for lack of knowledge of these therapeutic possibilities, or for lack of clinical experience. However, alveolar corticotomy by piezocision should be an integral part of the therapeutic arsenal to

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

speed up treatment in adults significantly, and to increase the range of possible dental movements. It requires better collaboration between orthodontists and periodontists.

It is a recent technique that is part of a new era in orthodontics. It has yet to be studied to improve our knowledge of bone metabolism and the physiology of tooth displacement in order to make it even more efficient and less invasive. Thus, it would push the boundaries of classical orthodontics.

References

1) Lavenus, Sandrine & Louarn, Guy & Layrolle, Pierre. (2010). Nanotechnology and Dental Implants. International journal of biomaterials. 2010. 915327. 10.1155/2010/915327.
2) Climent, Mariano & Costa, Carlos & Gil, F.J. & M, albertini & Nart, Jose. (2016). A Biomimetic Surface for Immediate and Early Loading of Dental Implants Surface Characterization and Results from Histological Studies. JSM Dental Surgery.
3) Abiodun-Solanke, Iyabode & Ajayi, Dm & Arigbede, Abiodun. (2014). Nanotechnology and its Application in Dentistry. Annals of medical and health sciences research. 4. S171-7. 10.4103/2141-9248.141951.
4) Pai, Umesh & Mundathaje, Mahesh & Mallya, Laxmish. (2016). Applications of nanotechnology in dentistry. Journal of International Medicine and Dentistry. 2. 186-203. 10.18320/JIMD/201502.03186.
5) Katić, & Šarić, Ankica & Despotović, Ines & Matijaković, Nives & Petković, & Petrović, Željka. (2019). Bioactive Coating on Titanium Dental Implants for Improved Anticorrosion Protection: A Combined Experimental and Theoretical Study. Coatings. 9. 612. 10.3390/coatings9100612.
6) Thakral, Gk & Thakral, Rashmi & Sharma, Neeraj & Seth, Jyotsana & Vashisht, Pallavi. (2014). Nanosurface-the future of implants. Journal of clinical and diagnostic research : JCDR. 8. ZE07-10. 10.7860/JCDR/2014/8764.4355.
7) Vaidya, Prutha & Mahale, Swapna & Kale, Sunila & Patil, Agraja. (2017). Osseointegration- A Review. IOSR Journal of Dental and Medical Sciences. 16. 45-48. 10.9790/0853-1601014548.
8) Ali, Shakhawan & Amin, Zanyar & Hama, Rebwar & Muhamed, Hawbash & Kamal, Rozhyna & Mahmud, Payman. (2019). All-On-Four Treatment Concept in Dental Implants: A Review Articles. Surgery & Case Studies: Open Access Journal. 2. 142. 10.32474/SCSOAJ.2019.02.000142.
9) Al-Hassani, Emad & Al-Hassani, Fatimah & Najim, Manar. (2018). Effect of polymer coating on the osseointegration of CP-Ti dental implant. AIP Conference Proceedings. 1968. 030022. 10.1063/1.5039209.
10) Al-Radha, Afya & Younes, Charles & Heard, Dr & Jenkinson, Prof. (2016). The Effect of Different Surface Modifications on Titanium Dental Implant Surface Characteristics and Bacterial Adhesion. IOSR Journal of Dental and Medical Sciences. 15. 62-70. 10.9790/0853-1508026270.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

11) Ali, Shakhawan & Othman, Kawan & Samad, Abduljaleel & Mahmud, Payman. (2019). Comparison between basal and conventional implants as a treatment modality in atrophied ridges. 38. 48-54.
12) Gupta, Shivangi & Dahiya, Varun & Shukla, Pradeep. (2014). Surface topography of dental implants: A review. Journal of Dental Implants. 4. 66. 10.4103/0974-6781.131009.
13) Yeo, In-Sung. (2014). Reality of Dental Implant Surface Modification: A Short Literature Review. The open biomedical engineering journal. 8. 114-9. 10.2174/1874120701408010114.
14) Sekar, V. & Sengottaiyan, Vinothkumar & Ganapathy, D.. (2019). Implant considerations and surface modifications - A literature review. Drug Invention Today. 11. 259-263.
15) Shen, James & Fäldt, Jenny. (2014). Requirements of Bioactive Ceramics for Dental Implants and Scaffolds. Advanced Ceramics for Dentistry. 279-300. 10.1016/B978-0-12-394619-5.00013-4.
16) Meng, Hsiu-Wan & Chien, Esther & Chien, Hua Hong (Ben). (2016). Dental implant bioactive surface modifications and their effects on osseointegration: A review. Biomarker Research. 4. 10.1186/s40364-016-0078-z.
17) Feller, Liviu & Jadwat, Yusuf & Khammissa, Razia & Meyerov, Robin & Schechter, Israel & Lemmer, Johan. (2015). Cellular Responses Evoked by Different Surface Characteristics of Intraosseous Titanium Implants. BioMed research international. 2015. 171945. 10.1155/2015/171945.
18) Tomsia, Antoni & Lee, Janice & Wegst, Ulrike G.K. & Saiz, Eduardo. (2013). Nanotechnology for Dental Implants. The International journal of oral & maxillofacial implants. 28. e535-46. 10.11607/jomi.te34.
19) Shetty, Neetha & Pralhad, Swati & David, K. (2013). Nanorobots: Future in dentistry. The Saudi dental journal. 25. 49-52. 10.1016/j.sdentj.2012.12.002.
20) Nathani, Rk & Venkata Ranganayakulu, Segu & Ealla, Kranti kiran Reddy. (2020). ROLE OF NANOTECHNOLOGY IN DENTAL SCIENCES: A REVIEW. International Journal of Research in Pharmaceutical and Biomedical Sciences. 4. 94-98.
21) Pachauri, Preeti & Bathala, Lakshmana & Sangur, Rajashekar. (2014). Techniques for dental implant nanosurface modifications. The journal of advanced prosthodontics. 6. 498-504. 10.4047/jap.2014.6.6.498.
22) Shariff, Suhail & Ayesha, Nuzhat & Bailwad, Sandeep & Singh, Manas & Agarwal, Dr & Sofat, Parneet. (2014). DENTAL IMPLANTS AND NANOTECHNOLOGY Introduction. 1.
23) Lee, Jae-Kwan & Cho, Lee-Ra & Um, Heung-Sik & Chang, Beom-Seok & Cho, Kyoo-Sung. (2013). Bone Formation and Remodeling of Three Different Dental Implant Surfaces with Escherichia Coli-Derived Recombinant Human Bone Morphogenetic Protein 2 in a Rabbit Model. The International journal of oral & maxillofacial implants. 28. 424-30. 10.11607/jomi.2751.
24) Duraccio, D. & Mussano, Federico & Faga, Maria. (2015). Biomaterials for dental implants: current and future trends. Journal of Materials Science. 50. 10.1007/s10853-015-9056-3.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

25) Shahi, R & Albuquerque, Maria Tereza & Münchow, Eliseu & Blanchard, Steven & Gregory, Richard & Bottino, Marco. (2016). Novel bioactive tetracycline-containing electrospun polymer fibers as a potential antibacterial dental implant coating. Odontology / the Society of the Nippon Dental University. 105. 10.1007/s10266-016-0268-z.
26) Wennerberg, Ann & Jimbo, Ryo & Albrektsson, T.. (2015). Implant Surfaces and their Biological and Clinical Impact. 10.1007/978-3-662-45379-7.
27) Hung, KUO-YUNG & Lo, Sung-Cheng & Shih, Chung-Sheng & Yang, Yung-Chin & Feng, Hui-Ping & Lin, Yi-Chih. (2013). Titanium surface modified by hydroxyapatite coating for dental implants. Surface and Coatings Technology. 231. 337-345. 10.1016/j.surfcoat.2012.03.037.

---

[i] Guddala, Narasimha & Pampana, Sravani & Yarram, Anusha & Sajjan, M C Suresh & Av, Ramaraju & Rao, Bhee-Malingeswara. (2019). Surface Modifications of Dental Implants: An Overview. International Journal of Dental Materials. 01. 17-24. 10.37983/IJDM.2019.1103.