Microscope-Assisted Implant Complication Management

Ramon Gomez-Meda and Jonathan Esquivel

Contents

Abstract

Accidents and complications are unavoidable from time to time when placing implants, but the surgeon should know how to prevent and treat those complications. The use of microscope, its illumination, and magnification allow the practitioner to increase the predictability of treatment, allowing better precision in managing the tissues. In some narrow and deep spaces, the use of the OM as its

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coaxial light facilitates a sharp field of view. The surgeon's abilities and predictability of surgical techniques increase, employing minimally invasive surgeries and solving several problems reducing treatment time, costs, and morbidity for the patient at the same time. This kind of dentistry becomes more gratifying and motivating for the practitioner and the whole team, reducing the patient's anxiety level.

Keywords

Implant complications · Accidents · Implant malposition · Periimplantitis Esthetic implant complications · Dental implants · Microscopy

1 Implant Complications

Placing implants may involve trans-surgical accidents that can affect the outcome of surgery or complications after the implant has integrated that can be categorized as early or late complications [1, 2]. With the increase in the number of implants placed, the number of complications has also increased. The clinician must be proficient, solving them to increase the chances of successful implant therapy.

Microsurgery with its increased illumination and magnification allows the practitioner to detect and manipulate the anatomical structures and soft tissues better, reducing surgical accidents and complications and, consequently, the morbidity, increasing this way the treatment success.

2 Trans-Surgical Accident

This type of accident includes implant malposition or displacement, soft tissue lesions, lesions to adjacent teeth, bleeding, dehiscence or fenestration, lack of primary stability, injury to neuro-sensorial structures, aspiration, or swallowing dental instruments, or mandibular fracture [3–8].

A thorough medical history, which includes an examination for the presence of coagulation disorders and other medical alterations that could potentially lead to complications, should be done [9].

A radiological evaluation with a cone-beam computed tomography (CBCT) is also essential to properly plan implant surgery [3]. A computer-aided design computer-aided manufacturing (CAD-CAM) generated surgical guide can avoid or reduce the chance of malpositioned implants and help to avoid dehiscence, fenestrations, or the damaging of vital structures.

Surgery in the anterior maxilla or mandible of edentulous patients with inadequate bone quality and quantity can compromise the sublingual, lingual, or submaxillary artery [6]. In these cases, the use of a microscope can help locate and identify arteries and nerves, avoiding any major bleeding or nerve damage (Figs. 1 and 2; Videos 1, 2, and 3).

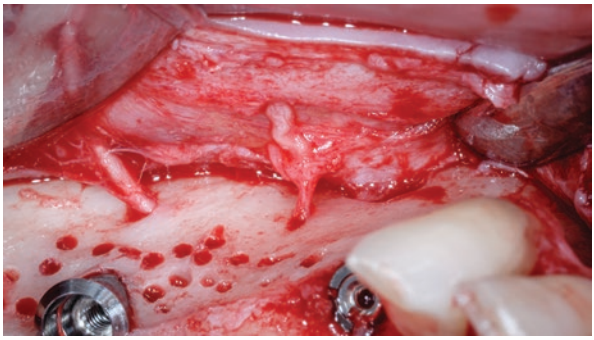

Fig. 1 Dental nerve emergences can be easily detected with the help of microscope

Fig. 2 Anatomical structures are isolated and visualized through the microscope preventing intraoperative accidents and early complications

Also, the use of microscope increases the care of soft tissues with a better instrument manipulation technique, reducing other types of accidents like flap tears due to excessive traction or incorrect use of instruments (Fig. 3) [4, 10, 11]. Flap elevation can be initiated with papilla elevators to avoid tearing the margins of the gingiva (Video 4). Also, microsurgical forceps, less invasive and smaller than macro-elevators, help manipulate the flap without traumatizing it.

A microsurgical approach may reduce the incidence of bone dehiscence and fenestrations that can be unnoticed in immediate implant placement or flapless surgeries due to the lack of visibility [12]. Also, 90% of cortical plates in the anterior zone are thinner than 1 mm [13], and magnification allows for better visualization. Cortical plate integrity can be easily and quickly assessed after tooth extraction, before immediate implant placement, without the need of raising a flap. For this purpose, increasing the OM magnification above 10× and even 20× is useful (Video 5).

There is no evidence that vertical dehiscence under 2 mm needs any guided bone regeneration procedure, reducing the morbidity for the patient (Figs. 4 and 5) [14]. A dehiscence larger than 2 mm needs bone regeneration procedures with non-resorbable or resorbable membranes [15] that can nowadays be approached microsurgically, eliminating or minimizing the extent of vertical releasing incisions and covering the wound with a tension-free closure of the flaps (Fig. 6) [7]. Although many surgeons use the operative microscope every day, the techniques for suturing

Fig. 3 Small flap tear that could be avoided with a more careful approach. The reduced dimension of the lesion did not require any additional therapy

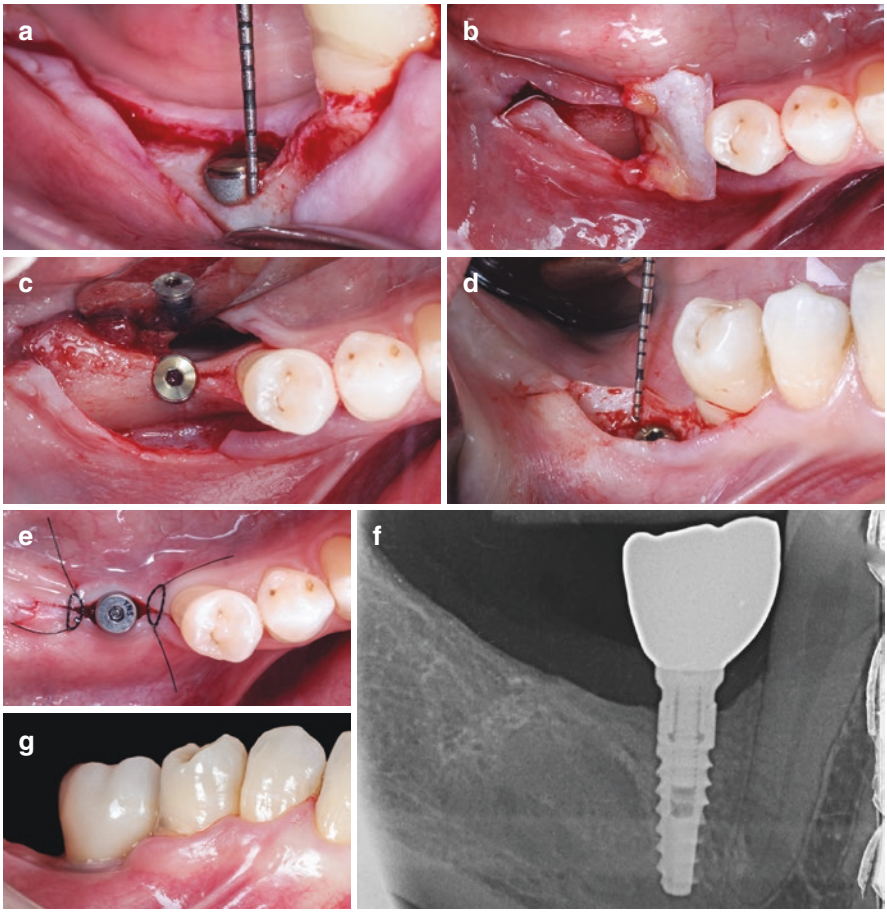

Fig. 4 (**a**–**g**) Small dehiscences under 2 mm do not need a bone regeneration procedure. Instead, the surgery can be simplified with a microsurgical approach using a CTG to increase the thickness and quality of the soft tissues around the neck of the implant reducing the bone remodeling of the crest

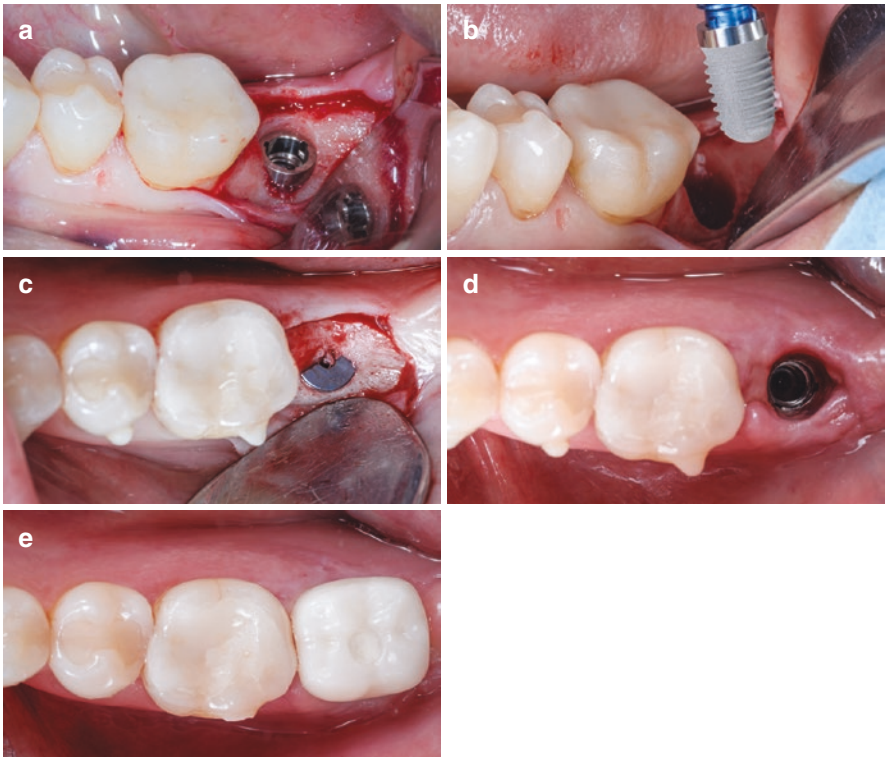

Fig. 5 (**a**–**e**) A tissue level implant is another treatment option when a small dehiscence, under 2 mm, is present due to a narrow crest. Surgery and interim restoration are shown in the pictures

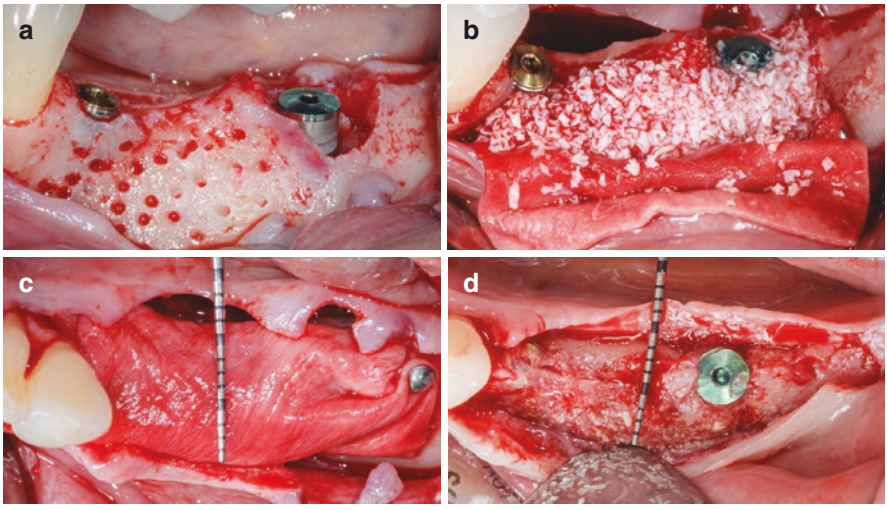

Fig. 6 (**a**–**d**) A guided bone regeneration procedure (GBR) is the treatment of choice to guarantee more than 2 mm of bone on the buccal aspect of the implant preventing a long-term dehiscence or fenestration and a possible implant failure

very small vascular and neural structures are more complex than the routinely used approach. Practicing microsurgical anastomosis techniques is beneficial for the clinician [16]. Mastering the microsurgical technique can help develop skills that can be applied to other areas of surgery [17]. To perform microvascular anastomosis, the clinician must have the adequate tools necessary. It is essential to use these instruments only for this procedure and not routine surgery to increase their longevity.

Several factors must be considered when selecting instruments. First, they should be comfortable to use; the shape of the handle affects the ability of the clinician to manipulate the instrument without losing control. The most common shapes are flat and rounded but can also have a knurled pattern. The clinician should use the handle shape and grip pattern they feel more comfortable with. It is crucial to consider the tension of spring-loaded instruments. If the tension is too weak, it will be hard to secure the tool, leading to excessive overclosure or the risk of dropping it. If the tension is too high, its use may require excessive effort leading to fatigue. The clinician should make a test for correct tension. In this test, should hold the instrument between his/her fingers and have the tips of the instrument partially closed. Then, the clinician should turn his or her hand over holding the position and check if the instrument tip rotates out of position, which would indicate a weak tension. Hand muscle fatigue after prolonged use is the best indicator of high tension in the instruments. An exercise the clinician can do is hold the instrument partially closed and measure how much time this position could be held without developing strain. The longer the instrument is held without fatigue, the longer the clinician can use the instrument in surgery.

The weight of the instrument is also important. Stainless steel instruments are heavier than titanium instruments and may have a firmer feel between the fingertips.

Finally, the length of the instrument handle determines a comfortable working distance. Regardless of the depth of the tissue, the clinician must be able to stabilize his or her hands using the fingers as support in areas close to the working surface.

3 Early Complications

Early complications can include edema, ecchymosis, hematomas, emphysema, bleeding, soft tissue dehiscence, sensitivity, and infection or implant fracture.

The microscope may reduce this kind of early complication as it allows for improved soft tissue manipulation and reducing edema and swelling.

3.1 Edema, Bleeding, Ecchymosis, and Hematoma

Swelling appears hours after a surgical procedure. It can lead to discomfort, trismus, or sensitive alterations due to compression of terminal branches of a nerve and may require corticosteroids [18]. The symptoms usually decrease with time and can quickly vanish after a few days. The extension of the surgical procedure and the general condition of the patient can induce bleeding after surgery. Minimal invasive

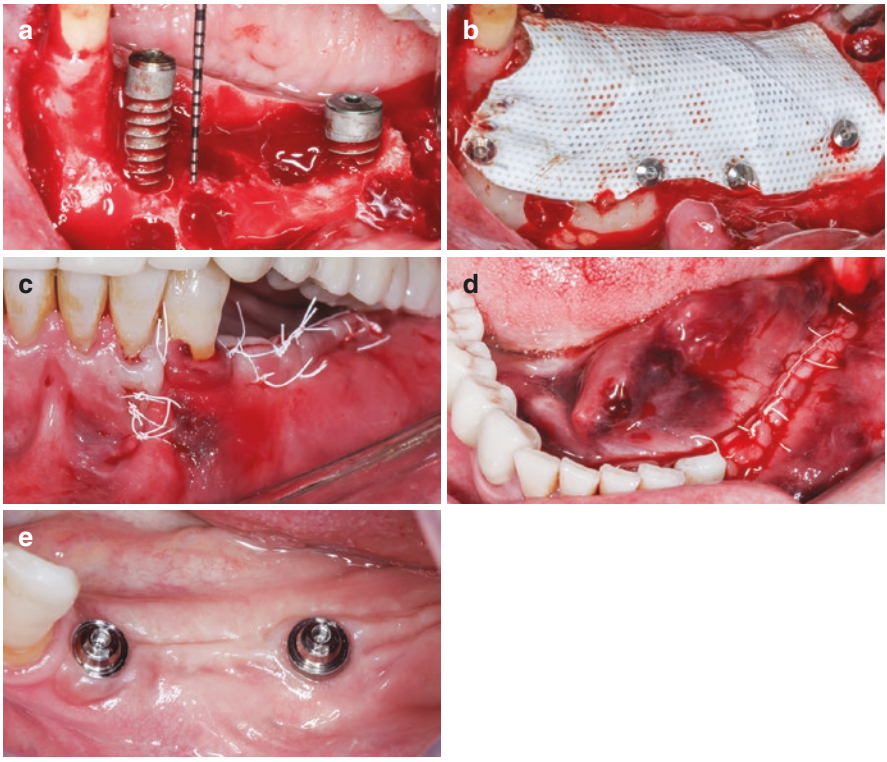

Fig. 7 (**a**–**e**) Important bleeding and swelling in the sublingual aspect of the mouth in a patient with medical problems. Even when using a careful and microsurgical approach, a previous comprehensive medical evaluation of patient condition is mandatory. Regardless of presence of an intrasurgical complication, vertical GBR procedure was eventually successful

surgeries and the identification of vital structures help avoid these kinds of complications.

Immediately placed implants and guided flapless surgery techniques have been shown to reduce the need for analgesic and anti-inflammatory drugs [19–22]. On the other hand, wider flaps like the ones necessary for guided bone regeneration of large defects are more prone to swelling, edema, and hematoma as the periosteum is cut to allow for tension-free suturing (Fig. 7). Careful management of tissues, using non-excessive tension, is paramount to reducing surgical trauma and, consequently, the edema and swelling (Fig. 8). The use of the microscope may help increase the care of the soft tissues and even allow to perform bone regeneration procedures without raising flaps, mainly at the time of implant placement (Fig. 9) [23, 24]. Traditionally, a flap was raised after detecting a cortical plate defect, and a collagen membrane plus a biomaterial or bone chips were used to regenerate the area. Nowadays, it is possible to work flapless even in the presence of large fenestrations and dehiscence, preserving the integrity of the soft tissues and avoiding the mobilization of the periosteum. Hard and soft tissues can be tunneled into the gap

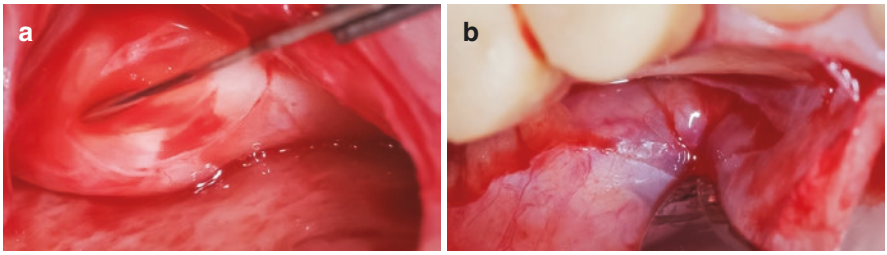

Fig. 8 (**a**, **b**) Magnification and good illumination are paramount when cutting periosteum to get a free-tension closure of flaps avoiding any damage to underlying tissues

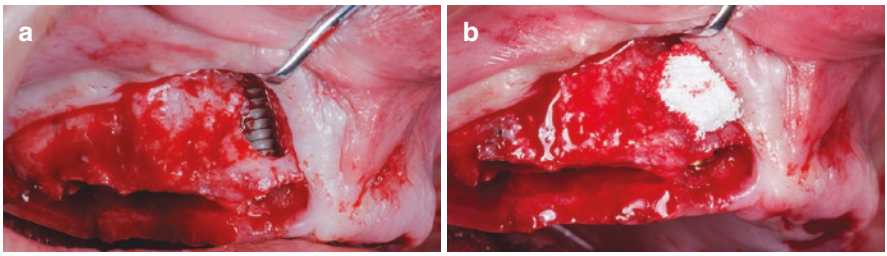

Fig. 9 (**a**, **b**) A microsurgical approach allows bone regeneration of a fenestration in buccal cortical plate after an immediate implant placement without fully raising a flap

between the immediately placed implant and the periosteum and therefore easily stabilized without the help of a membrane [25].

The microsurgical triad, described as the combination of magnification, illumination, and the surgical technique's increased precision, allows for the numerous advantages described above [11]. First of all, the operative microscope's (OM) magnification forces the surgeon to change protocols and ergonomics, improving his or her motor skills and surgical abilities. Better illumination makes it easier to work with tunneling techniques even in posterior areas keeping a sharp view of the surgical field and keeping the procedures minimally invasive. Finally, the possibility to use microsurgical instruments and sutures, along with the previously mentioned magnification, better illumination, and an improvement in motor skills, makes it possible to change the workflow and precision of the surgical techniques used, reducing tissue trauma and morbidity, speeding up the healing process with less swelling and pain.

3.2 Mucosal Dehiscence

The leading cause of surgical wound dehiscence is flap closure under tension [26]. In cases with thin biotype, scarring and traumatized tissues are prone to wound dehiscence, most commonly present in patients with medical problems such as diabetes, history of radiation therapy, use of corticosteroids, or heavy smoking. Connective tissue grafts are a good way to close wound dehiscence (Fig. 10), even

in more complex cases where the dehiscence leads to an oroantral fistula (Fig. 10) [27].

Attention should be given to minimize flap tension [28] and preserve the flap's blood supply [29] or using tunneling techniques, when possible, to preserve the vascularization of the recipient site and the grafts (Figs. 11 and 12; Videos 6 and 7). As mentioned before, this is an advantage with the use of the dental microscope [30].

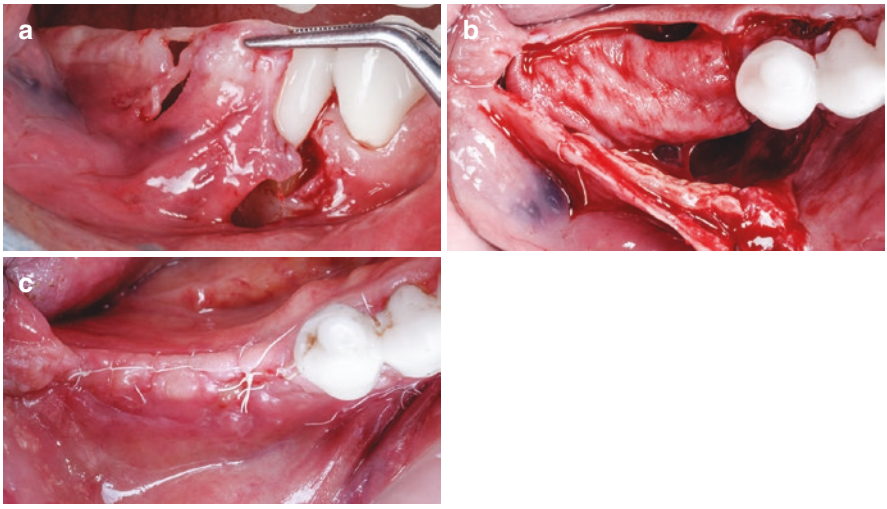

Fig. 10 (**a**–**c**). A more complex and bigger tear was repaired with an interpositional subepithelial connective tissue graft (sCTG) to avoid aborting bone regeneration surgery

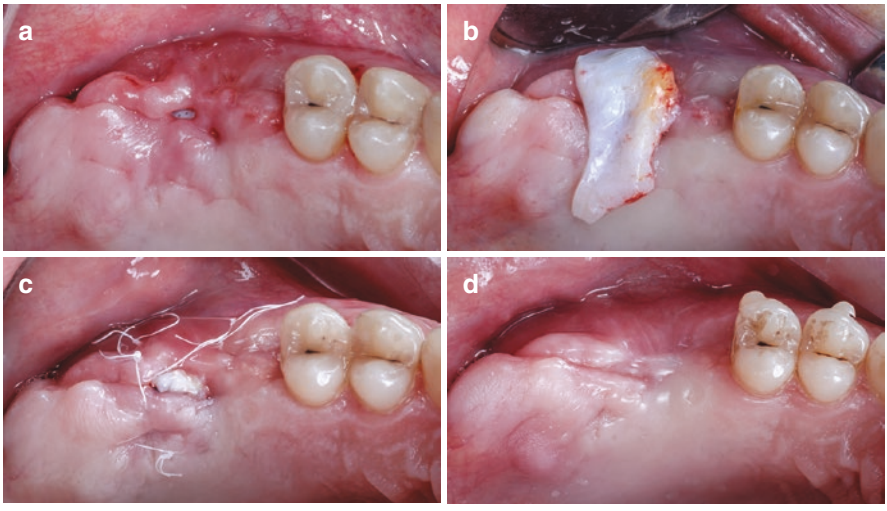

Fig. 11 (**a**–**d**) After a vertical GBR procedure with a non-resorbable PTFE-d titanium reinforced membrane an early small exposition was detected and solved using a sCTG tunneled through the dehiscence. Minimally invasive and microsurgical approach allowed to preserve integrity and vascularity of tissues allowing for a more predictable procedure

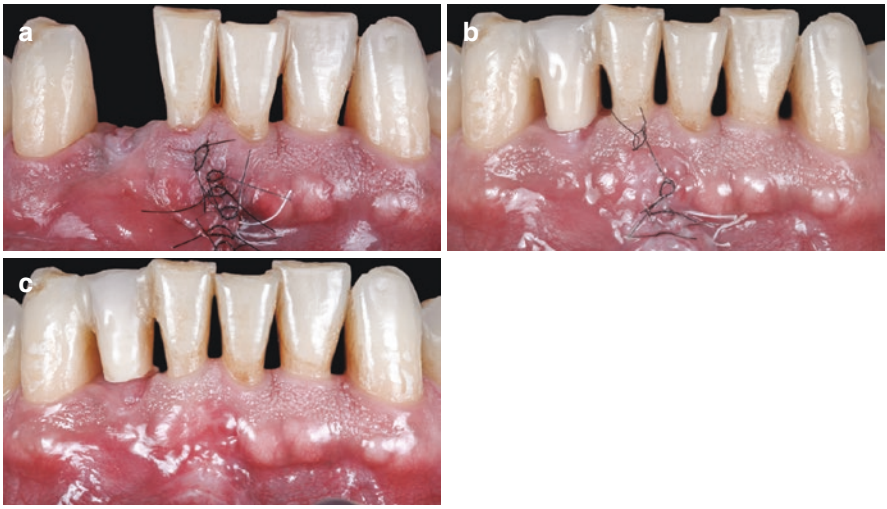

Fig. 12 (**a**–**c**). Precision of microsurgical suture after a tunneling technique to reconstruct hard tissues. After a few days healing was complete and a few weeks later no scars were visible

A well-designed flap along a microsurgical procedure reduces the chances of mucosal dehiscence. A well-designed flap is one with a minimum extension that would still allow to properly visualize the area and execute the surgical procedure without compromising its vascularization. It should have releasing incisions for tension-free closure to guarantee its integrity and avoid necrosis of the gingival margins. The use of special instruments such as smaller forceps, elevators, pliers, as well as sutures are important for success when using a microsurgical approach.

4 Late Complications

Late implant complications are classified into biological, biomechanical, and esthetic complications.

4.1 Mechanical Complications

Overload, non-axial loading, and biomechanical stress were considered for many years to compromise implant survival. Recent evidence has been published, suggesting that technical/mechanical risk factors do not affect implant survival or the surrounding bone [31].

Different mechanical complications may be present during implant therapy. The literature reports an incidence of screw loosening in 9% of the cases (Video 8), 4% for loss of prosthetic retention, and 3.5% incidence of veneering material fractures in 5 years [32].

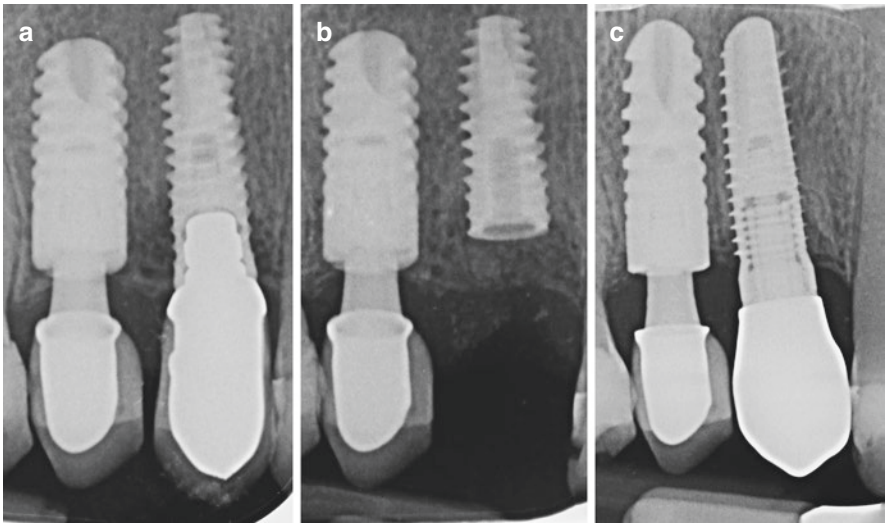

Fig. 13 (**a**–**c**) The microscope is extremely helpful when broken implants have to be extracted avoiding raising wider flaps and preserving most of the bone around the implant which has to be retrieved

An increase in the failure of some types of rehabilitations has been observed over 10 years. Different types of prosthetics designs exhibited varying incidence of complications: fixed dental prostheses (FDPs) with cantilever extensions on teeth (19.6%), combined tooth-implant-supported FDPs (22.3%), and resin-bonded FDPs (35.0%) [33]. These scenarios can lead to the need for multiple repairs and remakes, compromising the patient's quality of life. It has been reported that greater implant loss occurred in overdentures when compared to other prosthetic designs. Also, there is greater loss in the maxilla than mandible, and failure increases with short implants and poor bone quality [34].

Implant fracture is not frequent, among 0.2–1.5% of cases [35] and usually happens after 3–4 years of implant loading [36]. Very narrow implant design, overloading, parafunctional habits, or an ill-fitting prosthesis may lead to implant fracture (Fig. 13; Video 9) [37].

Fractures of prosthetic retaining screws are frequent due to metal fatigue [38]. The use of the microscope is advantageous when a screw has to be retrieved without damaging the implant (Video 10). In these narrow, deep, and tight spaces, it is advantageous to use the OM as its coaxial light (shadow-free) facilitates a sharp field of view, which would be otherwise almost impossible. This magnification and illumination make it easy to engage the broken screw or make a groove to retrieve it. Sometimes it is not possible to retrieve a screw because its remaining part keeps a high torque, and the engaging part gets damaged during the retrieving process (Video 11). In those cases, it is necessary to take out the implant. Magnification and

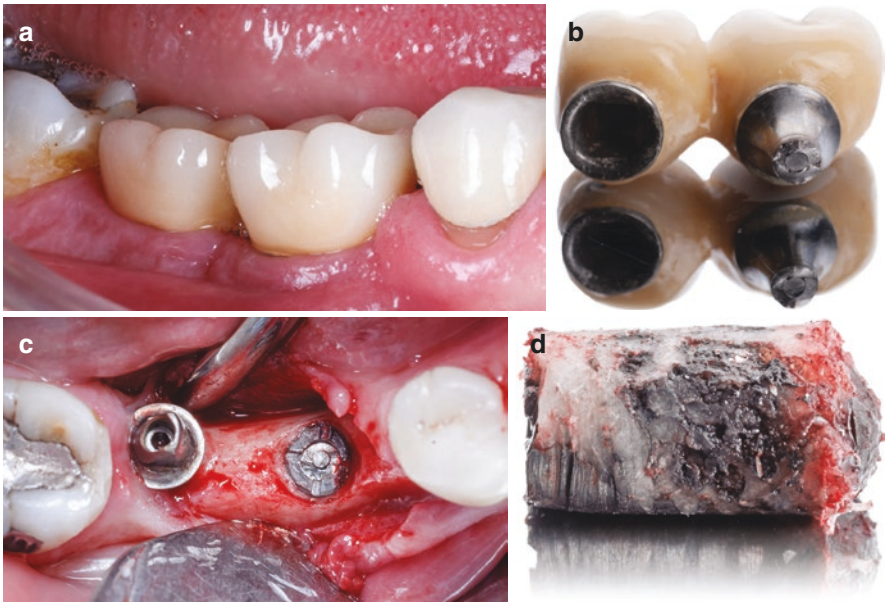

Fig. 14 (**a**–**d**) When the abutment inside the implant is broken it can be necessary to retrieve the implant. Good illumination and proper magnification allow a proper diagnosis and decision-taking

good visualization are helpful to retrieve the implant preserving the maximum quantity of bone around it avoiding future complex bone regeneration procedures (Fig. 14; Video 12).

4.2 Biological Complications

Biological complications include inflammation of the peri-implant tissue and implant loss [39]. Mucositis is described as an inflammation limited to the mucosa around the dental implant, whereas peri-implantitis involves losing supporting bone [40]. Biological complications and their treatment may lead to gingival recession or soft tissues collapse, compromising implant therapy's success.

Microorganisms found in peri-implantitis are very similar to those found in chronic periodontitis. Overall, the prevalence of peri-implantitis has been documented to range from 1.1% to 85.0%. The incidence has increased from 0.4% within 3 years to 43.9% in 5 years. Lack of hygiene measures, smoking, diabetes mellitus, and periodontitis were identified as risk factors of peri-implantitis [41]. Also, hard tissue resorption around the implant head can be accelerated due to an excess of cement into the peri-implant sulcus, which acts as the source of bacteria, causing inflammation and bleeding upon probing [42]. This may happen in 90% of the implant crowns inserted with cement [43].

The prevention of biological implant complications relies on careful planning, a thorough examination to assess etiological factors, and a regular maintenance recall schedule. Different treatment modalities have been suggested for the treatment of periimplantitis: non-surgical mechanical debridement, local and/or systemic antibiotics, lasers, gingivectomy with or without implantoplasty and regenerative surgery [43–46]. Mechanical and chemical decontamination techniques are still the most highly recommended [47].

The treatment option will depend on the amount of bone loss and the morphology of the peri-implant defect. Nonsurgical treatments are chosen in cases with mucositis or peri-implantitis that involve a defect smaller than 2 mm (Figs. 15 and 16). Peri-implant defects with more than 2 mm bone loss that do not respond to decontamination usually require surgical treatment: gingival resection or apically positioned flap, with or without implantoplasty or guided bone regeneration [48–50]. Although there is no consensus among previous studies, peri-implant defects, including circumferential defects within the bony housing and 2/3-wall intrabony defects, appear to have more regenerative potential (Fig. 17) than those which have lost the cortical bone plates. Conversely, resective therapy (i.e., an apically positioned flap) should be considered in defects with moderate bone loss that do not have a good regenerative potential (Fig. 18). Additionally, to reduce plaque accumulation and facilitate patient home care, implantoplasty is recommended at the time of resective surgery (Fig. 19; Video 13). Nonsurgical treatment modalities can maintain mild peri-implant disease cases [51]. Removal of the implant is the ideal treatment option if the bone loss is beyond 50% of the implant surface or if mobility is present.

With the increasing popularity of implant therapy, biological implant complications are essential issues that cannot be ignored. In addition to comprehensive examination and a thorough treatment plan understanding and preventing the risks, proper surgical technique and regular maintenance play roles in preventing implant biological complications. The microscope magnification and better illumination allow the surgeon to assess the peri-implant defect better and clean the implant's surface. The smoother soft tissue management may avoid wider flaps reducing the morbidity for the patient and increasing the predictability of the guided bone regeneration techniques due to the tension-free closure of the wound and a better clot stability.

4.3 Esthetic Implant Complications

The esthetic sector is a challenging area to treat with dental implants. Attention to detail is required to increase the chances of a successful outcome. Good visualization and lighting are crucial elements to allow for this to happen. According to Jung, the cumulative five-year esthetic complication rate is approximately 7.1% [32].

Esthetic complications in dental implant therapy include gingival recession, soft tissue collapse, grayish color around gingiva, and scaring as a consequence of previous surgeries [52–58]. These esthetic complications are mainly relevant in patients

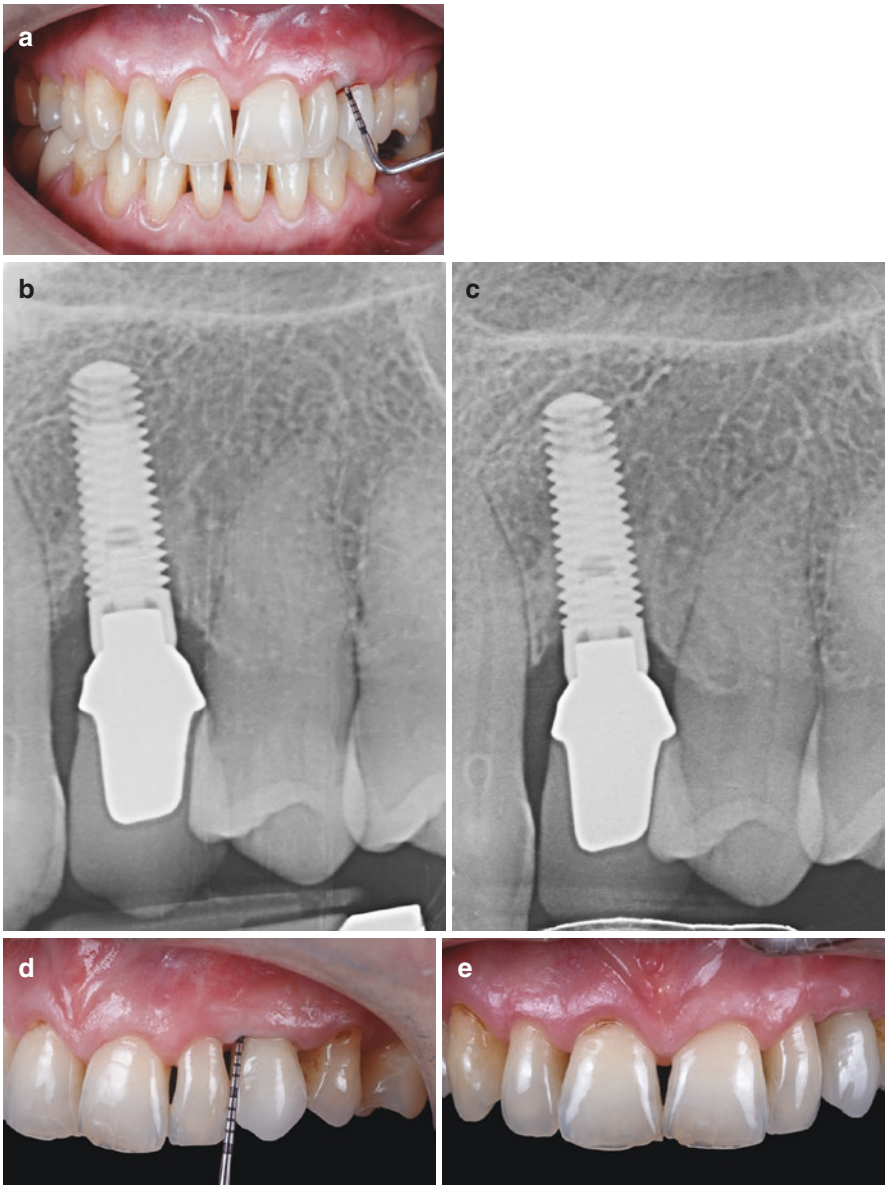

Fig. 15 (**a**–**e**) Mechanical debridement in a case with periimplantitis due to excess of cement

with a high gingival display, and they should be evaluated following the Pink and White esthetic scores (PES WES) [59, 60].

Several risk factors can promote esthetic implant complications: implant position and prosthesis design, hard and soft tissue condition, and the surgical technique used.

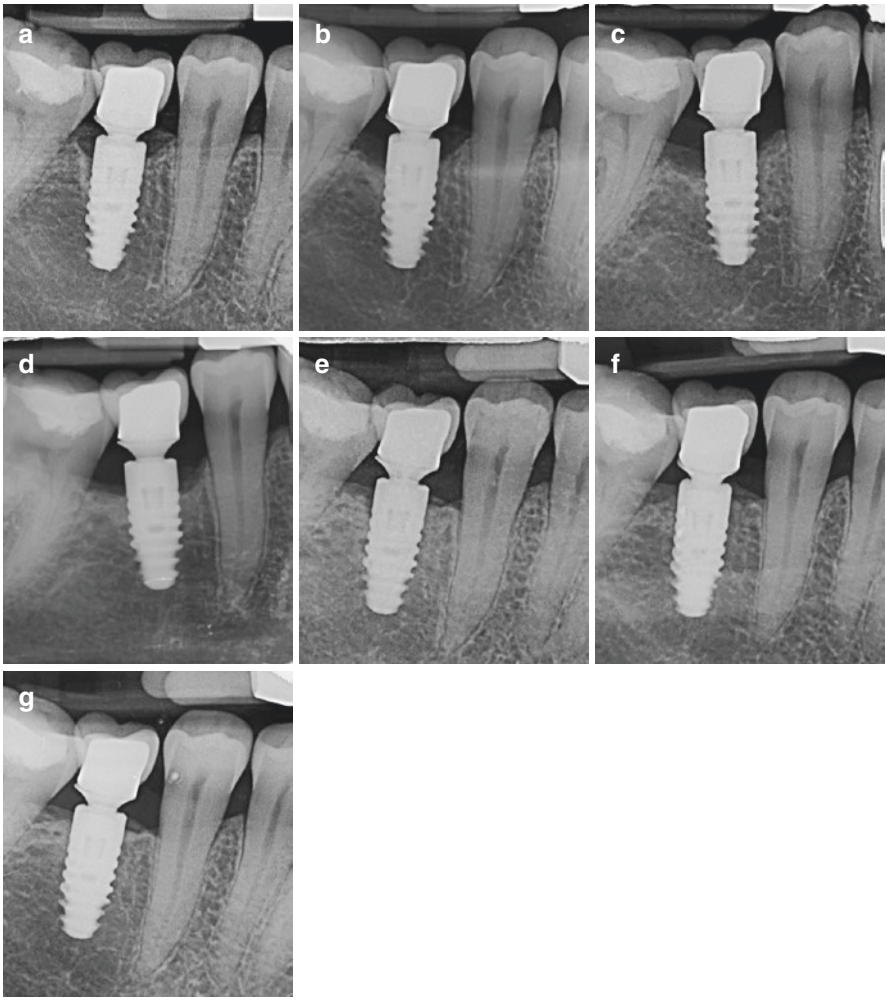

Fig. 16 (**a**–**g**) Mechanical debridement in a case with periimplantitis and very good evolution through the years without the need for a surgical procedure

4.3.1 Implant Position and Prosthesis

During the past decades, implant dentistry has evolved from a "surgically driven concept" to a "prosthetically driven concept" to avoid future esthetic, prosthodontic, and biological complications [61, 62]. When an implant is placed too facially or the implant or abutments used are too wide, a gingival recession can occur (Fig. 20).

Gingival recession is mainly present in thin phenotypes where the gingival recession can be three times larger than in a thick phenotype (1.5 vs. 0.6 mm) in only 4 years [63].

When a gingival recession is present, the implant is of adequate size and is not placed buccally, the treatment is predictable, and a partial or total cover can be

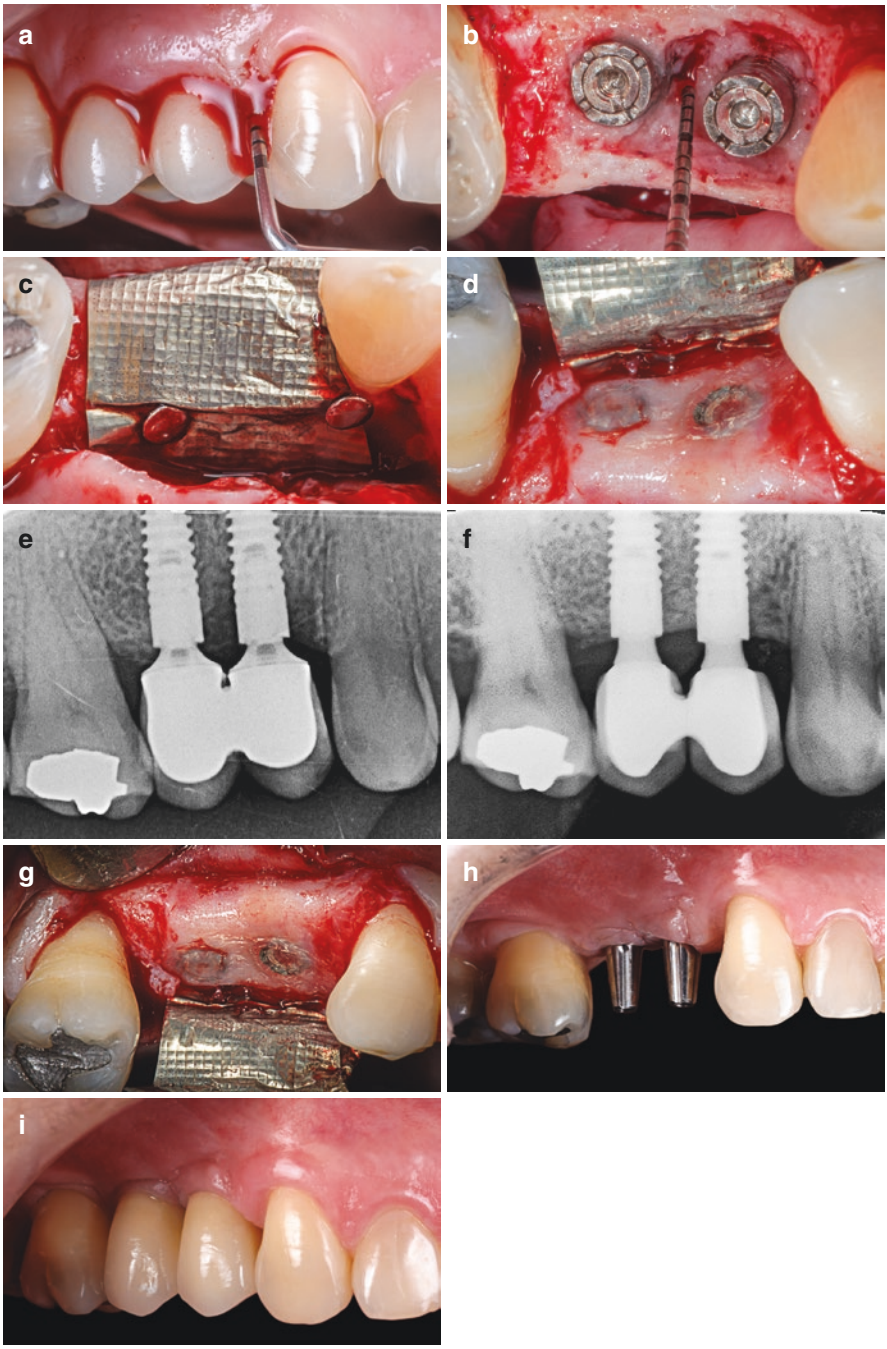

Fig. 17 (**a**–**i**). GBR after decontamination of the surface of the implants

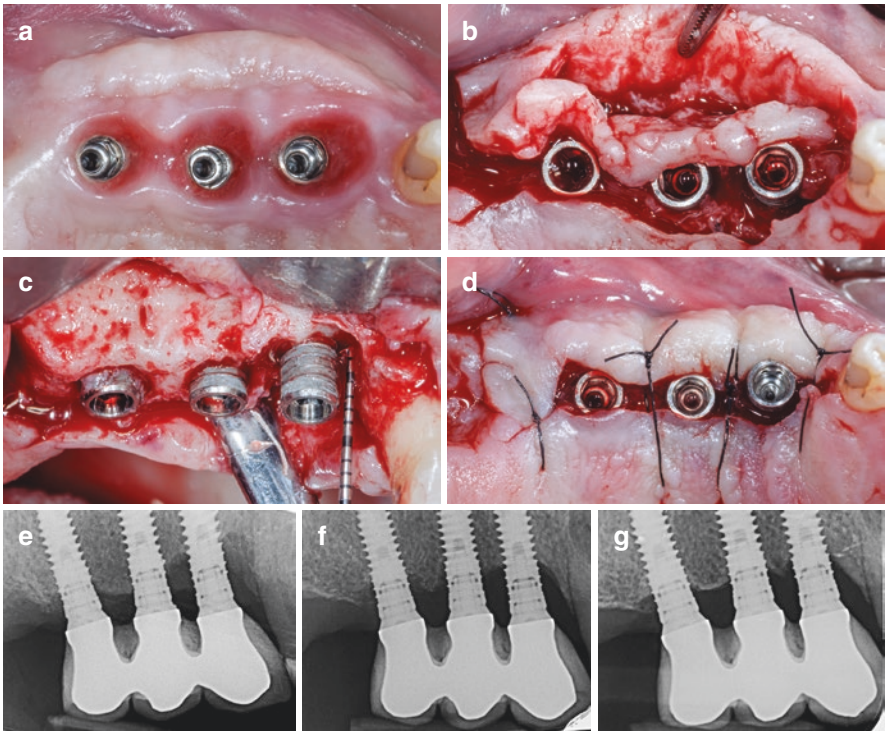

Fig. 18 (**a**–**g**) Gingivectomy and decontamination of the surface to treat advancing periimplantitis. As a result, a good stability of the bone crest can be observed years later. Radiographs taken in 2014, 2016, and 2020

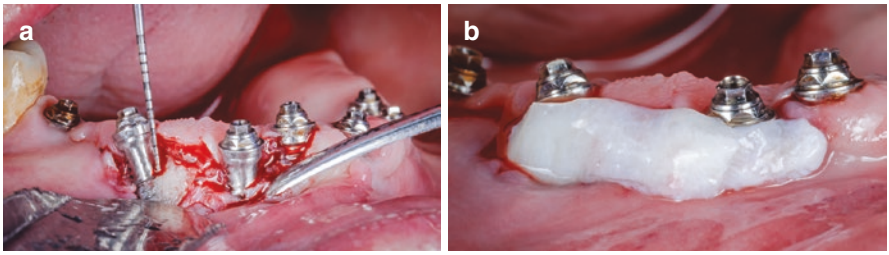

Fig. 19 (**a**, **b**) Implantoplasty and CTG to improve soft tissue condition on the buccal side of an implant-supported rehabilitation in a patient without gummy smile

expected [55, 64–66]. A perio-prosthodontic approach can be beneficial, combining a coronally advanced flap and a connective tissue graft with an abutment or temporary restoration with a narrower diameter [54, 64, 65]. When the abutment design is correct, a tunneling approach may be sufficient to solve the problem, and the implant crown can be replaced immediately, making the procedure simpler (Fig. 21).

Fig. 20 When the patient does not present a gummy smile implant gingival recessions do not always need to be treated if implants are healthy

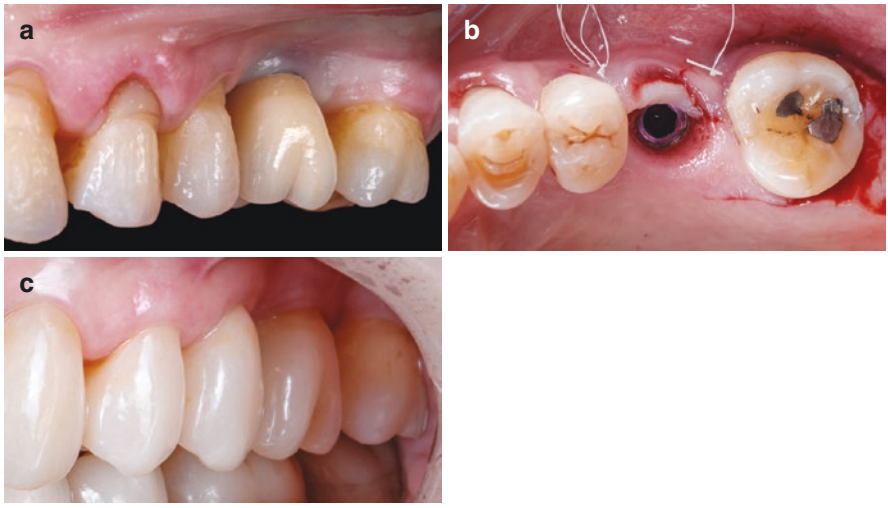

Fig. 21 (**a**–**c**) Tunneling technique is used to increase the volume of the gingiva and the band of keratinized gingiva on the buccal aspect of an implant

The implant head and the abutment contour should not surpass the line connecting the adjacent teeth cervical area. Gingival recessions can be avoided by positioning the implant neck at the cingulum of the future restoration. Filling the gap between the cortical plate and the implant body with a biomaterial reduces the socket's collapse. In thin phenotypes, connective tissue grafts tunneled on the buccal may help avoid gingival recessions [63, 67]. The abutment's emergence profile should be concave to allow space for the soft tissues (Fig. 22) [68, 69]. This space can be augmented in occasions with implantoplasty if the implant's malposition is not severe or when the esthetics implications are not relevant because the patient does not present a gummy smile (Fig. 19) [70, 71]. When implants are badly malpositioned and not restorable, the treatment should be started all over again.

If the emergence angle of the abutment is greater than 30 degrees, the space for soft tissues will be reduced and may be a significant risk indicator for periimplantitis. A convex profile creates an additional risk for bone-level implants [72].

Fig. 22 Ideal emergence profile which includes the EBC zones, preserving the Crestal bone with a straight emergence profile emerging from the implant head, stabilizing the soft tissues with a concave Bounded buccal surface and a convex Esthetic zone

4.3.2 Phenotype

A thin buccal cortical plate and bone dehiscence's are usually related with thin phenotypes and are associated to gingival recession [73]. When the thickness of the gingiva is less than 1.5 mm, a grayish color of the abutment, or the neck of the implant can be seen through the gingiva (Fig. 23) [74].

The mucosa can be thickened to get more stable and esthetic results around implants (Fig. 24) [75–77].

The lack of keratinized tissue is still a controversy today. Some authors fail to demonstrate its relationship with inflammation and recession around implants [78]. Other authors suggest that the lack of keratinized tissue promotes bone remodeling and, consequently, gingival recession [79]. An apically positioned flap and a free gingival graft may prevent the recession, improve the patient's hygiene levels, and even prevent mucositis or periimplantitis (Fig. 25) [80, 81].

4.3.3 Surgical Technique and Morphology of the Recession

The risk of gingival recession is higher after immediate implant placement if no additional measures are taken or when many surgical procedures are executed [82, 83]. Combining a connective tissue with the immediate implant placement helps avoid many surgeries that usually compromise the proximal tissues; however, a 0.5 mm papilla contraction may still be observed [67, 84]. Papilla reconstruction procedures are unpredictable and should be prevented when possible [74, 85].

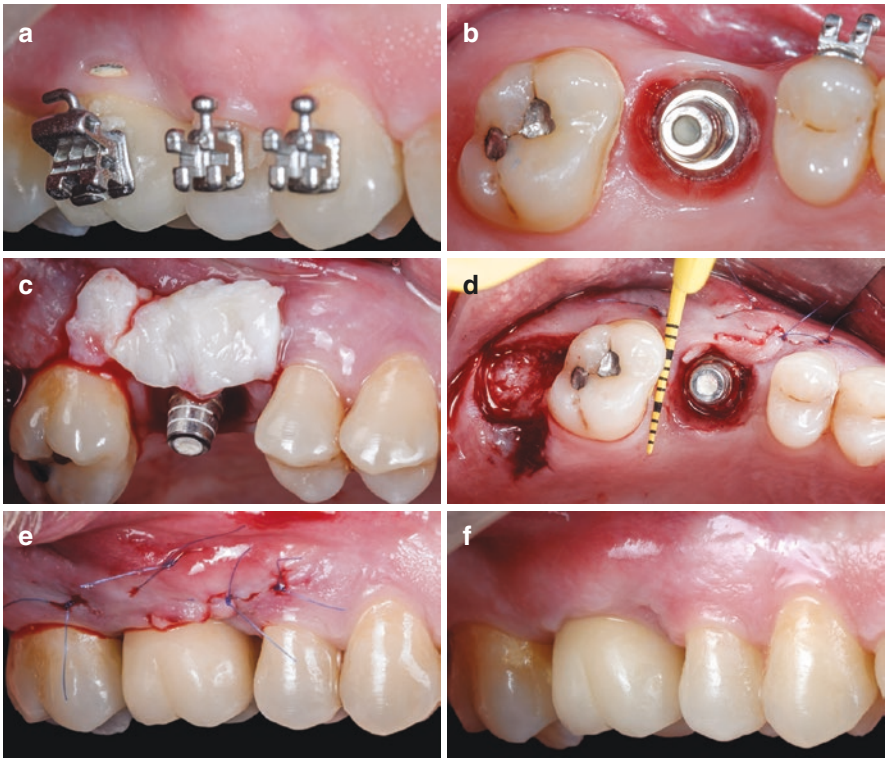

Fig. 23 (**a**–**f**). A microsurgical approach allowed to improve the quality and quantity of soft tissues after momentarily retrieving the implant-supported crown

The healing process around teeth and implants is similar, but the peri-implant soft tissues' complete maturation takes longer [86]. The stability of the blood clot between the flap and the wound bed is a key point to guarantee a healing process without complications, and suturing techniques are paramount to ensure optimal surgical outcomes [86]. With the help of microscope, the surgical results are becoming more predictable and repeatable, providing good clinical results for the patient and reducing the healing time and morbidity. Treating recessions around implants is less predictable than around teeth because of the reduced vascularization and the different orientation of the collagen fibers. For this reason, implant explantation can be a more predictable approach sometimes [87].

Before taking a final decision about preserving or explanting an implant, several points should be evaluated: the number of implants involved, size and location of the problem, design, and fit of the abutment, the quantity of bone on the buccal and proximal sides, as well as the size and condition of the gingival recession.

Coronally advanced flaps (CAF) and CTG have been used successfully to cover recessions around implants in three retrospective studies [55, 64, 71]. Only some studies show complete recession coverage, but patient satisfaction is high even

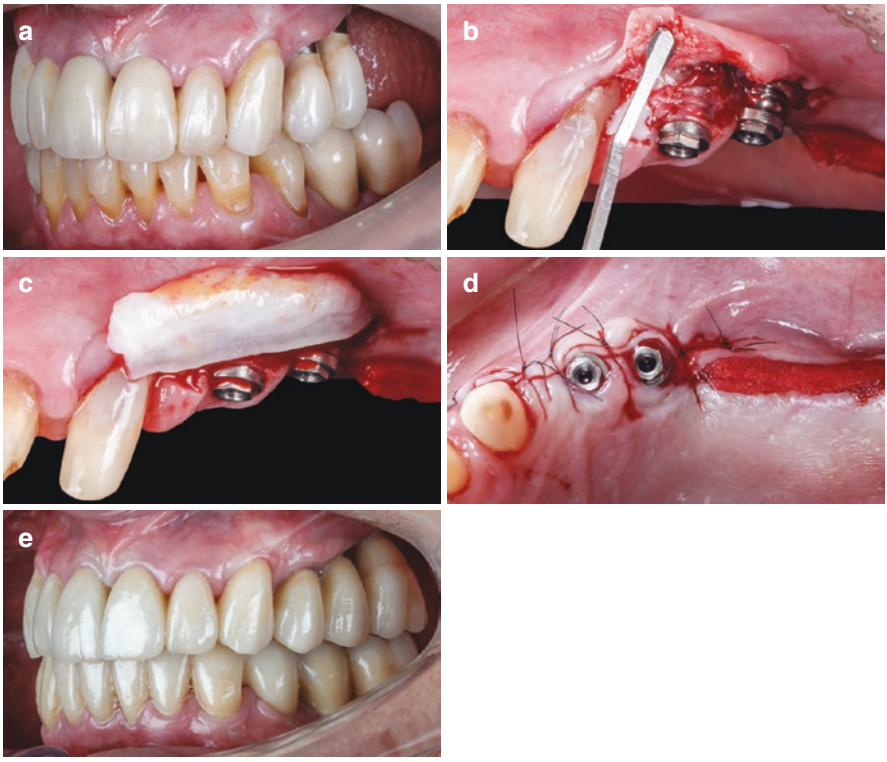

Fig. 24 (**a**–**e**) CAF plus a CTG is a very predictable way to treat gingival recessions on implants

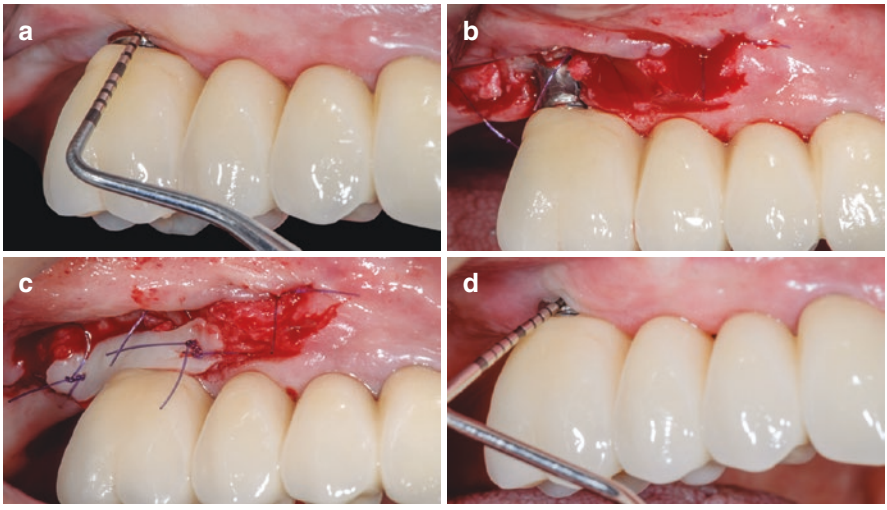

Fig. 25 (**a**–**d**) Apical positioned flap, implantoplasty, and FGG to increase the band of keratinized tissue and the vestibule dimensions in a patient with difficulties for hygiene

when full coverage of the recession was not achieved (Fig. 24) [71, 88, 89]. Releasing incisions to advance coronally the flap reduces the vascularization of the flap and can induce scar tissue that can be observed years later [58, 90–93]. For these reasons, a "pouch" technique is advisable for mild recessions (Fig. 23; Video 14).

Even when biomaterials have been used to cover recessions around implants such as Acellular Dermal Matrix (ADM), the connective tissue graft (CTG) seems the most predictable approach with the best results [66, 71, 94–96]. The CTG should have at least 2 mm thickness. The area or technique used to harvest the CTG may not be relevant. Single incision in the palate, de-epithelialized grafts from the palate, and tuberosity grafts have been used with similar results [97]. Connective tissue from the tuberosity is denser, and the morbidity is low, but its disadvantage is the scarce quantity and the overgrowth that may happen over time (Fig. 23) [98].

4.3.4 Papilla Reconstruction

Jemt classified the gingival papilla status into five grades: 0, lack of papilla; 1, <50% of the volume of the papilla is present; 2, between 50% and 100% of the volume of the papilla is present; 3, papilla volume is perfect; 4, overgrowth of the papilla [99]. The distance from the contact point to the bone crest can predict the filling of embrasure by the proximal soft tissue [100]. When this distance is less than 5 mm, the papilla will fill the embrasure 100% times, and this decreases as the contact point moves farther from the bone crest.

The papilla height between two implants is reduced when compared to other scenarios [101]. If a pontic site is next to the implant, the papilla height can be reconstructed to achieve even 5.5–6 mm (Fig. 26).

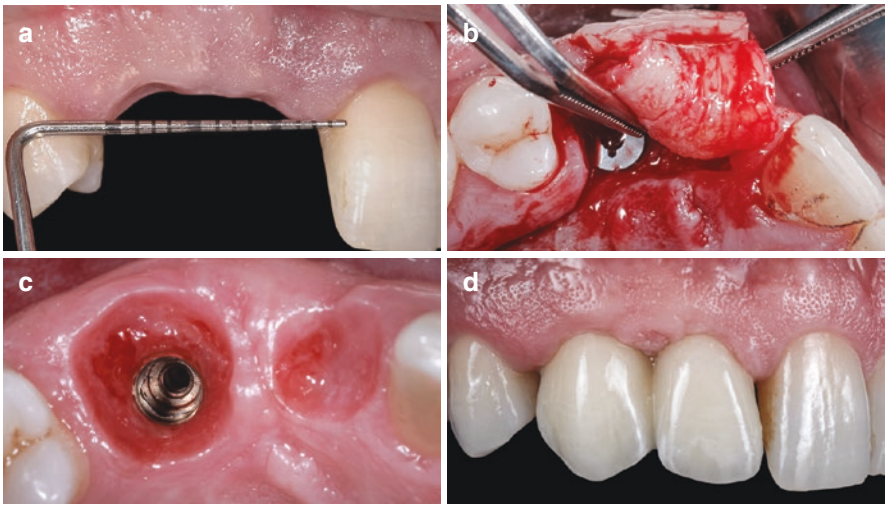

Fig. 26 (**a**–**d**) Pontic site reconstruction and papilla development using a perio-prosthodontic approach combining a pedicled palatal CTG with a long-term interim restoration

Fig. 27 (**a**–**e**) A combination of orthodontic, periodontal, prosthodontic, and restorative therapies was used in this complex case to reconstruct the soft tissues and papillae

Papilla reconstruction is unpredictable and requires microsurgical experience, but it can be done by applying several soft tissue augmentation procedures [88, 99, 102], a combination of bone regeneration and soft tissue grafting [103], orthodontic treatment plus restorative treatment (Fig. 27) [104, 105], tunneling techniques [106], or a combination of different techniques, the orthodontic extrusion being the most predictable [107–111].

Pink ceramic can also be used to resolve very severe defects, but consideration should be given to difficult hygiene maintenance and the possible esthetic non-pleasant result in patients who expose the transition area [112].

5 Conclusions

In dentistry, the expertise of the surgeon, his visual-spatial abilities, attitude, and capacity to cope with stress are determinants that affect the selection of the technique and its predictability [113–116].

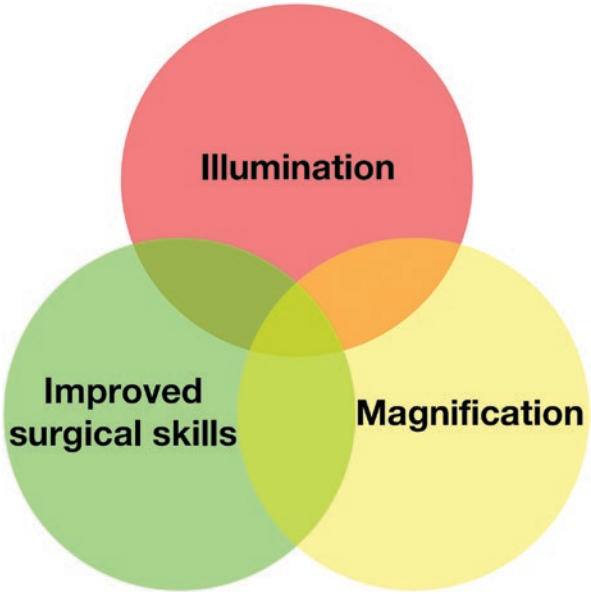

Fig. 28 The microsurgical triad: the visualization is improved with a good magnification and illumination of the surgical field. This ends up improving the surgical skills of the surgeon due to the continuous challenge to his abilities

Shanelec and Tibbets introduced the use of microscopy in periodontics at the American Academy of Periodontology's Annual Meeting in 1992 [117]. Since then, many clinicians have been introducing the microscope into their practices. The combination of small microsurgical instruments and delicate surgical techniques allows for extremely fine, crisp, and accurate incisions, gentle tissue handling, and precise suturing. Other advantages are less discomfort to the back and less eye strain [118].

A better and more precise soft tissue management through magnification and a better illumination allow the surgeon to increase progressively his abilities and the predictability of his surgical techniques driving this process to a different approach employing minimally invasive surgeries and being able to solve several problems reducing treatment time, costs, and morbidity for the patient at the same time. Moreover, this kind of dentistry is more gratifying and motivating for the practitioner and the whole team, reducing the patient's anxiety level (Fig. 28).

The use of microscope has some disadvantages: need of education in the field, more time-consuming at the beginning, limited surgical field, and higher costs for the patient. So, it can only be justified if the predictability of the clinical results is increased significantly. That is the case in hard and soft tissue surgical procedures where the microsurgical handling of the anatomical structures seems to compensate for the effort of using a microscope. Of course, treating implant complications with a microsurgical approach opens a new era in dentistry, increasing the predictability of the techniques used [119].

6 Key Points

1. Implant placement may involve trans-surgical accidents that can affect the outcome of surgery or complications after the implant has integrated that can be categorized as early or late complications.
2. The microscope's use increases the care of soft tissues with a better instrument manipulation technique, reducing accidents like flap tears due to excessive traction or incorrect use of instruments.
3. The operative microscope's (OM) magnification forces the surgeon to change protocols and ergonomics, improving his/her motor skills and surgical abilities.
4. Better illumination makes it easier to work with tunneling techniques even in posterior areas, keeping a sharp view of the surgical field and minimally invasive procedures.
5. The possibility to use microsurgical instruments and sutures, along with the previously mentioned magnification, better illumination, and an improvement in motor skills, makes it possible to change the workflow and precision of the surgical techniques used, reducing tissue trauma and morbidity, speeding up the healing process with less swelling and pain.
6. OM drives the treatment to a different approach employing minimally invasive surgeries and solving several problems reducing treatment time, costs, and morbidity for the patient at the same time.
7. Moreover, this kind of dentistry is more gratifying and motivating for the practitioner and the whole team, reducing the patient's anxiety level.

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