STARCH INDUCED IMPLANT PERIAPICAL LESION:

A CASE REPORT

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Abstract

This paper presents an unreported etiology of implant periapical lesion (IPL). The presence of an osteolytic area around the apex and around the middle portion of a stable Straumann hollow screw implant was found on periapical radiographs 3.5 years after implant placement. Case management involved curettage of the soft tissue surrounding the implant apex as well as resection of the non-osseointegrated portion of the implant. Histopathological examination revealed a connective fibrous tissue containing a dense chronic inflammatory infiltrate with a foreign body material. Polarized light microscopy and Fourier Transform Infrared (FTIR) micro-spectroscopy identified the foreign body material as starch particles. Etiology of this IPL was thus related to a foreign body reaction to starch particles. This exogenous contamination probably originated from starch coated gloves during the surgical procedure. This case report suggests that IPL may successfully be treated by debridement and implant resection instead of implant removal. Peri-implant apical soft tissue should be systematically submitted for histopathological examination.

Key words: dental implants, apical peri-implantitis, implant failure, radiolucency, granuloma, starch

Introduction

Implant periapical lesion (IPL) is a rare pathology. Single case reports[1-5] and two studies[6,7] have been published. In 1995, Reiser & Nevins[6] observed 10 IPLs out of 3800 examined implants. Recently, Quirynen et al.[7] reported 10 IPLs out of 539 single implants. IPL, as a distinct entity, was first introduced by McAllister et al.[8] Synonyms are “apical peri-implantitis” or “retrograde peri-implantitis”.[9]

IPL is usually suspected on clinical symptoms. The initial clinical manifestations of IPL are swelling and tenderness in the region of the affected implant, subsequently followed by a sinus tract.[10] Radiographically, radiolucency is found at the apical portion of the implant, while the coronal portion is still supported by normal bone architecture in contact with a clinically stable implant. Differential diagnosis of IPL includes: pre-existing “necrotic bone” infection, infection from a neighbouring tooth or contamination during surgery. Pathogens (bacteria) are considered to be at the origin of IPL.

This paper reports on a case of IPL associated with a foreign body reaction to starch particles. To our best knowledge, this etiology has never been previously reported. The patient was successfully treated by implant apical resection and thorough curettage.

Case report

A 56-year-old Caucasian woman in good general health presented with a painful swelling in the area of the right cheek. Clinical examination revealed an abscess in the apical region of a 14 mm long Straumann hollow screw implant supporting a single crown in position 15 (ADA 4). A periapical radiograph showed the presence of an osteolytic area around both the apex and the middle portion of the implant (Fig 1).

Probing depth was less than 3 mm and the cervical peri-implant soft tissues showed no signs of inflammation. The implant had been placed 3.5 years ago. Before implant placement, the post-extraction healing period was 5 months. Tooth extraction was carried out due to a failing endodontic treatment with periapical radiological signs of pathosis.

Systemic antibiotics were prescribed during 12 days (amoxicillin Amoxi-Mepha®, Mepha Pharma SA, Aesch, Switzerland; 750 mg, 3 times per day) as initial treatment. After one week, the inflammatory symptoms abated but a sinus tract with a mild purulent discharge developed in the following days. A mucoperiosteal exploratory flap was performed in order to determine the possible infection causes.

Flap reflection revealed a bone fenestration of the vestibular cortical plate with about 5 mm of residual cervical bone. An inflammatory tissue surrounded the apical portion of the implant. Upon debridement, yellowish exudate was present and an oroantral communication was observed. The perforated and hollow design of the implant apex did not allow a thorough curettage of the region. Thus, amputation of the non-osseointegrated implant extremity was decided, thereby eliminating the implant perforations. Resection was performed with a tapered fissure bur under copious irrigation. The resulting bone cavity communicated with the maxillary sinus but did not involve the adjacent teeth.

There were no post-operative complications and healing has been uneventful. Recurrence of the sinus tract was not observed over a two-year follow-up period, a nearly complete new bone formation was radiographically visible around the resected area (Fig 2). The implant is still in place, stable and functional.

Histopathological examination of the curetted tissue around the implant extremity revealed a connective fibrous tissue containing a dense chronic inflammatory

infiltrate consisting of lymphocytes, plasma cells and occasionally histiocytes (Figs 3 and 4). Numerous small round foreign bodies were observed and some of them were phagocytized by voluminous macrophages. These foreign particles were birefringent under polarized light and showed the typical aspect of a Maltese cross that might be attributed to starch.

To confirm the presence of starch particles in the inflammatory tissue, physico-chemical characterization was carried out by Fourier Transform Infrared (FTIR) micro-spectroscopy. The FTIR micro-spectroscope (Spectrum Spotlight 200 FTIR Microscope System, PerkinElmer, Schwerzenbach, Switzerland) was operated in reflection mode between 500 and 4000 cm^{-1}. This technique generates infrared signals of the whole inclusion area. It enables identification of differences in chemical compound and spatial distribution of sample features like individual contaminants.[11,12] Tissue sample was embedded in paraffin wax and sections were deposited on a microscope glass slide coated with silver nanoparticles. The measurements were performed at room temperature.

A FTIR map of a 2.06 mm^2 cross section is showed in Fig 5a, built out of the total absorbance of the sample. It shows the specimen and the surrounding paraffin matrix. Inside the tissue, FTIR spectra were recorded at the three marked points 7, 8 and 9 (Fig 5a). They are displayed in Fig 5b. Spectrum 7 showed 2850-3000 cm^{-1}, 1450-1470 cm^{-1} and 1370-1380 cm^{-1} vibration bands. They are typical of alkane-like paraffin compound absorption. Spectrum 8 exhibited peaks at 1630 cm^{-1} and 1520 cm^{-1}, corresponding respectively to amide I (-C=O) absorption and amide II (-NH-) absorption bands of cellular tissue proteins. Compared with spectrum 8, spectrum 9 identified a new band at around 1030 cm^{-1}. This vibration, identified as C-O absorption band, is typical of a polysaccharide-like starch.

Fig 5c shows a FTIR map, obtained at high magnification, with a typical protein absorption band (1520 cm^{-1}) of a sample area. This mapping allowed discrimination between the curetted material of the IPL and the surrounding paraffin. Fig 5d presents a mapping of the spatial absorbance distribution of starch in this area. The starch distribution in the tissue is not homogeneous. Starch particles seem to agglomerate in clusters. Fig 5d shows isolated starch particles of about 15 ± 5 µm in diameter.

Discussion

The presence of a delimited endo-osseous radiolucency may evoke a retrograde apical pathosis. It can also be due to excessive drilling depth or it can be associated with an implant placed in a pre-existing intrabony scar lesion. These cases refer to "non-infected" retrograde peri-implant radiolucencies and they only require clinical and radiological follow-up.[10]

To date, little is known about the etio-pathogenesis of IPL. It appears to have a multifactorial origin.[13-15] IPL is thought to be related to pre-existing bone infection[16], residual root particles or foreign bodies[6] introduced during surgery.[4] Furthermore, overheating[2,8], excessive tightening, aseptic necrosis of the bone inside the hollow portion of the implant[3], infected endodontic lesion from an adjacent tooth[4,8,16,17] have all been proposed as etiologic factors. Nevertheless, these hypotheses are not supported by scientific data. Quirynen et al.[7] observed that the incidence of IPL was significantly higher for implants with rough surfaces when compared with machined implants; however, the machined implant surface showed a higher failure rate than the rough implant surface.

In the field of oral and endodontic surgery, it is recommended in clinical practice to histologically analyze every endo-osseous or periapical lesion, in order to obtain a definitive diagnosis.[18] Final diagnosis of the IPL should also fall under this recommendation. Histological examination should allow differentiation between inflammatory related and non inflammatory related pathologies (central giant cell granuloma, metastasis, etc.).[19,20]

Histological examination was reported for five case reports. In those instances, final histopathological diagnoses were the following: acute localized osteomyelitis[1], aseptic bone necrosis[2-4] and granulation tissue with acute inflammatory cells.[5] This last diagnosis was obtained from biopsied tissues without implant removal whereas the four others were retrieved after implant removal.

IPL associated with a foreign body reaction due to starch particles has never been reported so far. Starch is added to rubber gloves as a lubricant, although many unwanted consequences are associated with its use like contact irritation and allergic reactions. Natural rubber latex proteins leak out of latex gloves and bind to surgical glove powder, this complex is responsible for latex allergy.[21] For many years, gynaecological and visceral surgeons have already highlighted the risks of post-operative granuloma formation, due to glove powder contamination of the surgical wound.[19,22-24] Starch granules are found in surgical wounds proportionally to the number of the surgical team members using powdered gloves.[25] In fact, different alternatives to powdered gloves do exist and certain medical institutions and centres have actually chosen to eliminate glove powder from their environment.[26]

In the oral surgery literature, only a single case of foreign body reaction to starch particles was reported following extraction. It appeared as a firm submucosal nodule,

5 mm in diameter, in the buccal sulcus, which was excised 20 days after teeth extraction.[27]

In dental implantology, the risk of starch contamination by medical gloves was evoked by Field[21] and Belvedere and Lambert[28] as a source of complications. Although manufacturers recommend fixture insertion with a specific instrument, one cannot totally rule out some accidental contact. Moreover, most surgical instruments, like spirals drills or depth gauge, are manipulated with gloves.

Many foreign bodies are able to produce an inflammatory reaction and could explain some implant failures. They can be introduced at the implant site during dental procedures (endodontic and restorative obturation materials), extraction procedures or implant surgery.

In order to prevent the occurrence of the IPLs, it is important to thoroughly debride the infected socket following extraction. Implants have to preferentially be placed after bony socket maturation when lesions are no longer visible on radiographs.[10] It also appears that foreign bodies may still dwell inside the bone and trigger IPL, even after thorough debridement, irrigation of the extraction sockets and sufficient healing time. Contamination of the implant site should be prevented. Implants should never come in contact with saliva, teeth, oral tissues or surgeon's gloves. Both careful implant site selection and surgical technique may further reduce the incidence of infected IPL. [6]

In the presence of an IPL, the choice of therapy is difficult. So far, there is no consensus report to which therapy should be favoured. To date, several treatment options are reported, ranging from the use of anti-infectious medication, lesion excision and debridement to implant removal. Different factors may influence treatment choice: implant stability, peri-implant probing depth, adjacent teeth status,

implant position and angulations. Moreover, the type and quality of the prosthetic rehabilitation should also be taken into account.

Anti-infectious therapy may be effective to treat the acute phase and adjunctive to the surgical treatment. This will rarely suffice to totally eliminate the underlying pathology.

Implant removal will usually be accompanied by considerable bone loss and the remaining bone along with the surrounding soft tissues will be altered. After several months of healing, an autologous bone and/or gingival graft may be necessary. The subsequent healing period as well as the difficulties inherent to this type of complex treatment may discourage the patient from pursuing implant therapy. Hence, a conservative surgical treatment, as described in this paper, may be proposed as a valid attemptable treatment option, as opposed to fixture removal. Furthermore, this will provide a histological diagnosis which may lead to complementary treatments. This treatment approach has the advantage of maintaining the implant in function.

Resection of the apical portion of the implant may be indicated when the geometry (implant type) does not allow proper debridement. Therefore, implant removal should be considered only as a last resort, when debridement has proven unsuccessful.

Any adjacent tooth which could be the source of infection should be considered for extraction if untreatable. It may therefore be possible to eliminate retrograde infection by debridement and hence maintain the implant if it clinically remains stable and if the infection is restricted to the endo-osseous region. [8,9,29] Implant resection should facilitate complete mechanical debridement of the inflammatory granulation tissue.

Apex sectioning may be especially indicated in cases of perforated implant type. [6,10,30] In addition to the conservative surgery, some authors have proposed the use of biomaterials. [5,6,10,29] Literature data does not warrant their systematic use.

In the present case, only implant resection and debridement were performed. This treatment has been attempted for the following reasons: implant stability, presence of residual cervical bone in the coronal part, bone fenestration instead of dehiscence. Graft material has not been used because of the presence of cervical residual bone.

After two years follow-up of the resective surgery, the radiograph shows a normal crestal bone level.

Conclusion

Exogenous contamination may provoke an IPL of an osseointegrated implant even several years after implant insertion. Although the occurrence of starch induced granuloma seems to be rare, the use of starch coated gloves should be avoided during surgical procedures. In order to identify the etiology of the pathosis, curetted tissues should be systematically histopathologically analyzed. The development of such a lesion should be considered as a complication rather than a failure. In this case, the IPL has been treated by implant debridement and resection, rather than by implant removal. This conservative approach has been effective and has maintained the implant in function.

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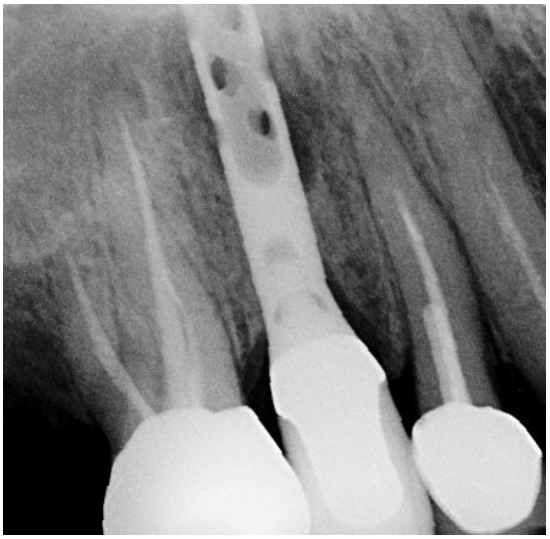

Fig 1 Preoperative radiograph revealing the presence of an implant periapical lesion around a hollow screw perforated implant.

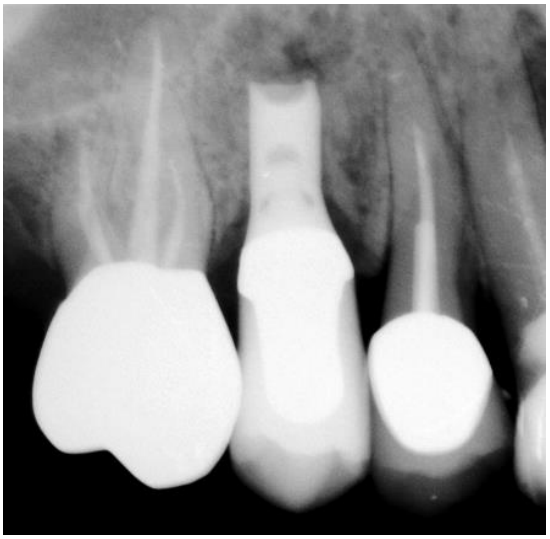

Fig 2 Radiograph taken two years after implant resection. Note the nearly complete new bone formation.

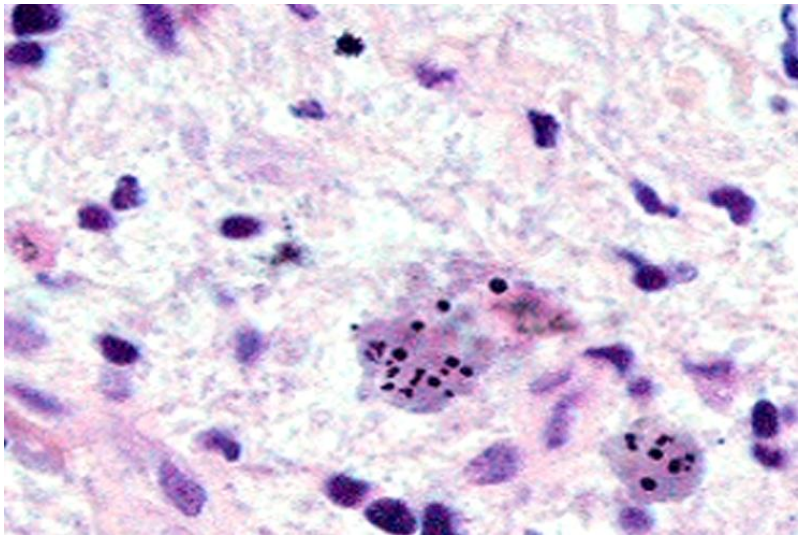

Fig 3 Histopathological examination of the tissue biopsy. Foreign particles were mainly phagocytized by macrophages.

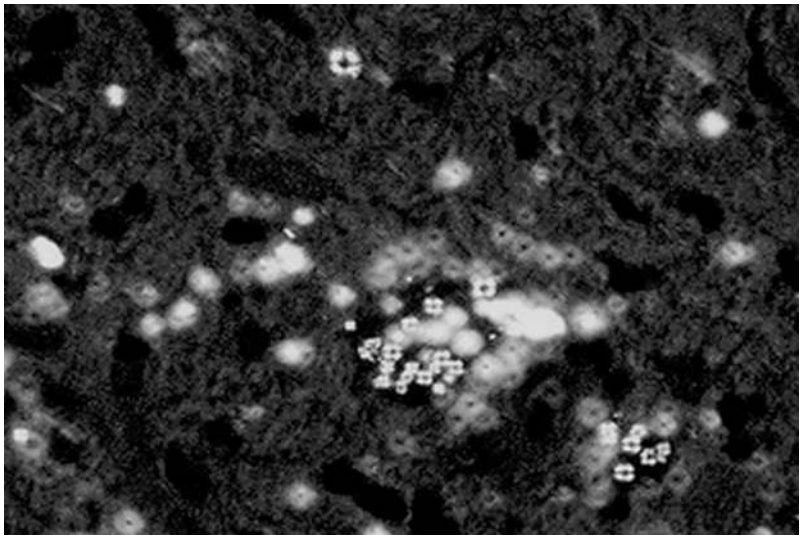

Fig 4 Histopathological examination under polarized light of the tissue biopsy. The foreign particles showed the typical Maltese cross aspect.

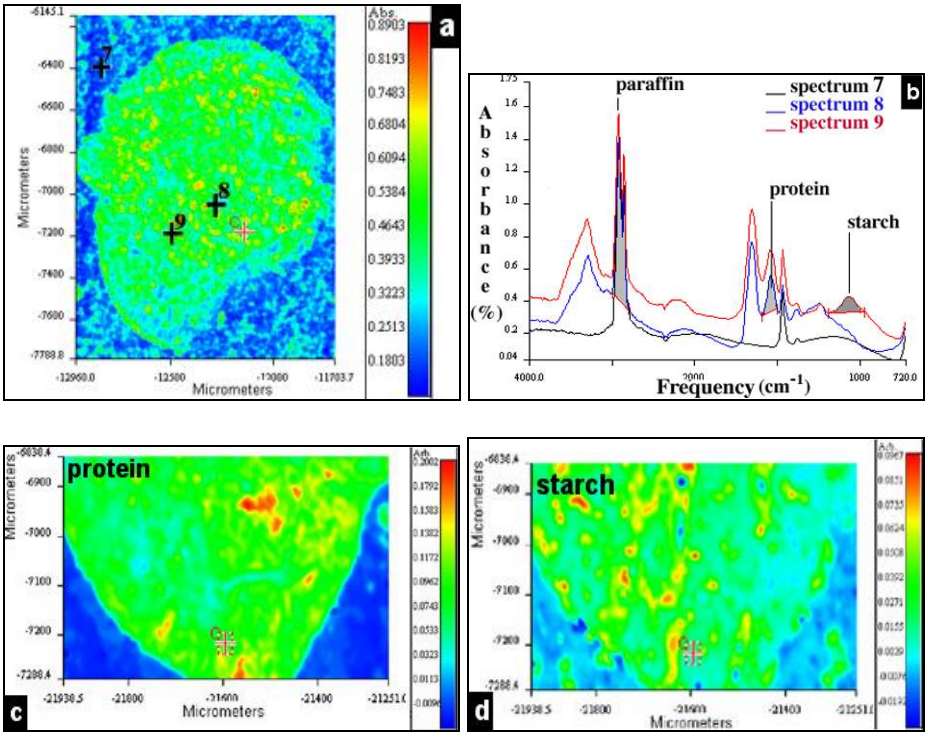

Fig 5 FTIR analysis of the biopsy.

(a) FTIR map of the total absorbance of a granuloma cross section. The crosses marked 7, 8 and 9 correspond to three different points of analysis.

(b) FTIR spectra recorded at the points marked 7, 8 and 9 in Fig 5a.

(c) FTIR map obtained with a typical protein absorption band (1520 cm^{-1}).

(d) FTIR map obtained with a starch absorption band (1030 cm^{-1}) of the same area.