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Dental floss remnants may predispose to peri-implant bone loss: A case report

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Abstract

Peri-implant mucositis and peri-implantitis are common but complex conditions which are associated with the accumulation of a plaque biofilm. A high standard of daily oral hygiene is considered a prerequisite for implant success and longevity. Universally accepted professional guidelines for implant maintenance do not exist, so various products and techniques are used by patients. This report describes a case of peri-implantitis which developed and progressed rapidly after a long period of health. Upon surgical exploration, remnants of dental floss were identified and removed from the peri-implant sulci, which likely predisposed to the onset of disease. This case highlights the importance of individualised oral hygiene advice and long-term follow-up for implant patients.

Introduction

As the acceptance of implant-supported restorations increases, their associated complications are becoming more apparent. It is now recognised that implant survival is not necessarily interchangeable with implant success. Survival simply implies that the implant is still present in the mouth, while success indicates that the implant is functioning as desired; biologically, mechanically, and aesthetically. Various criteria have been proposed to evaluate dental implants, considering factors such as the health of the peri-implant tissues, prosthetic complications, and patient satisfaction (Papaspyridakos et al. 2012). The prevention and management of biological complications (peri-implant diseases) is a primary concern for practitioners.

The consensus report from the 2017 World Workshop on the classification of periodontal and peri-implant conditions presented case definitions for peri-implant health, peri-implant mucositis, and peri-implantitis (Berglundh et al. 2018). Peri-implant mucositis is an inflammation of the peri-implant mucosa, somewhat analogous to gingivitis around teeth (Heitz-Mayfield and Salvi, 2018). It is characterised by bleeding on gentle probing, although other signs of inflammation such as erythema, suppuration, or swelling may be noted (Berglundh et al. 2018). Swelling or reduced resistance to probing may manifest as increased peri-implant probing depths, but this is irrelevant for diagnosis. Importantly, peri-implant mucositis occurs in the absence of continuous marginal bone loss, which distinguishes it from peri-implantitis (Heitz-Mayfield and Salvi, 2018). Peri-implantitis is characterised by inflammation of the peri-implant mucosa with progressive loss of the supporting bone (Schwarz et al. 2018). A clinical diagnosis of peri-implantitis is made in the presence of bleeding and/or suppuration on gentle probing, increasing probing depths, and evidence of progressive bone loss when compared to previous radiographs (Berglundh et al. 2018). In cases where previous clinical or radiographic examinations are unavailable, a diagnosis of peri-implantitis is assigned when probing depths measure 6mm or greater with bleeding and/or suppuration, and the radiographic bone level is greater than 3mm apical to the most coronal portion of the intraosseous portion of the implant.

There is substantial evidence implicating plaque as the primary cause of peri-implant disease. Experimental studies in animals and humans have identified a cause-and-effect relationship between the accumulation of a bacterial biofilm and the development of peri-implant mucositis (Pontoriero et al. 1994; Berglundh et al. 1992; Zitzmann et al. 2001; Salvi et al. 2012). Peri-implant mucositis is considered a precursor to peri-implantitis; a longitudinal study reported that patients with peri-implant mucositis were nearly twice as likely to develop peri-implantitis in the absence of regular professional maintenance care (Costa et al. 2012). Although the exact mechanism of the conversion to destructive, irreversible disease remains unclear, there is a widely-held opinion that peri-implantitis is an infectious condition similar to periodontitis. Albrektsson et al. (2020) recently presented an alternative view, termed the immunologic theory. The authors proposed that titanium implants are foreign bodies which initiate a protective immune reaction. An occasional imbalance in this response can result in marginal bone loss followed by secondary bacteria-mediated bone resorption. Further research in this area will continue to shape our understanding of the mechanisms underlying peri-implant bone loss and guide future management strategies for peri-implantitis.

Nevertheless, a high standard of oral hygiene and regular professional maintenance care remain important prerequisites for implant success and longevity (Monje et al. 2019). Higher plaque levels or limited access for homecare are significantly associated with peri-implantitis (Costa et al. 2012; Ferreira et al. 2006; Serino and Ström, 2009). While the importance of self-performed oral hygiene has been recognised, there is little evidence to support a superior regime for implant care (Louropoulou et al. 2014; Grusovin et al. 2008). Due to a lack of implant-specific oral hygiene

guidelines, professional advice varies widely and is sometimes not provided at all (Cheung et al. 2021; Mattheos et al. 2012).

Several studies have compared manual and powered toothbrushes and reported inconsistent results, other than the superiority of powered toothbrushes for patients with limited manual dexterity (Swierkot et al. 2013; Truhlar et al. 2000; Wolff et al. 1992). There is a paucity of well-designed studies evaluating the effectiveness of interproximal cleaning aids such as interproximal brushes, dental floss, and oral irrigators around implants (Chongcharoen et al. 2012). One study found no improvement in clinical parameters but relatively high acceptance of interdental brushes by patients, suggesting that they preferred faster and simpler methods of interproximal cleaning (Kreve et al. 2016). Water irrigation devices have been proposed as an alternative, but there is little compelling evidence for their efficacy. One randomised controlled trial reported that water flossers were more effective at reducing bleeding on probing around implants than string floss (Magnuson et al. 2013). This study was, however, partially funded by the manufacturer and its results may be at risk of bias.

Dental floss is frequently used by patients for daily implant maintenance. It is advantageous because it can be adapted around the cylindrical implant collar to remove plaque from within the peri-implant sulcus. Circumferential flossing techniques have been described, which guide the floss apically by crossing over the ends to encircle the implant, while running backwards and forwards (Chen and Darby, 2003; Montevecchi et al. 2016). Spongy-type floss with a stiffened end may be recommended to improve access beneath restorations. While floss is relatively affordable, accessible, and simple to use, there is minimal evidence to support its efficacy (Corbella et al. 2011). In addition, several case reports have recently described peri-implant bone loss associated with retained dental floss remnants within the sulcus (van Velzen et al. 2016; Montevecchi et al. 2016). These remnants have been proposed as a possible initiating factor for peri-implantitis, which has raised concerns about the safety of implant flossing.

Figure 1. A clinical photograph showing the inflamed peri-implant mucosa surrounding 11 and 21 at the initial consultation.

Case Report

A 65-year-old New Zealand European male was referred by his general dentist to a specialist periodontal clinic regarding progressive bone loss around implants at the 11 and 21 sites, which had been placed 14 years prior. The patient's medical history was non-contributory. He was experiencing some food impaction around the implants and noticed an unpleasant odour when cleaning his teeth. The patient's oral hygiene routine included twice daily brushing with a manual toothbrush and daily cleaning around his implants with dental floss utilising a cross-over technique (Colgate Total Tartar Control

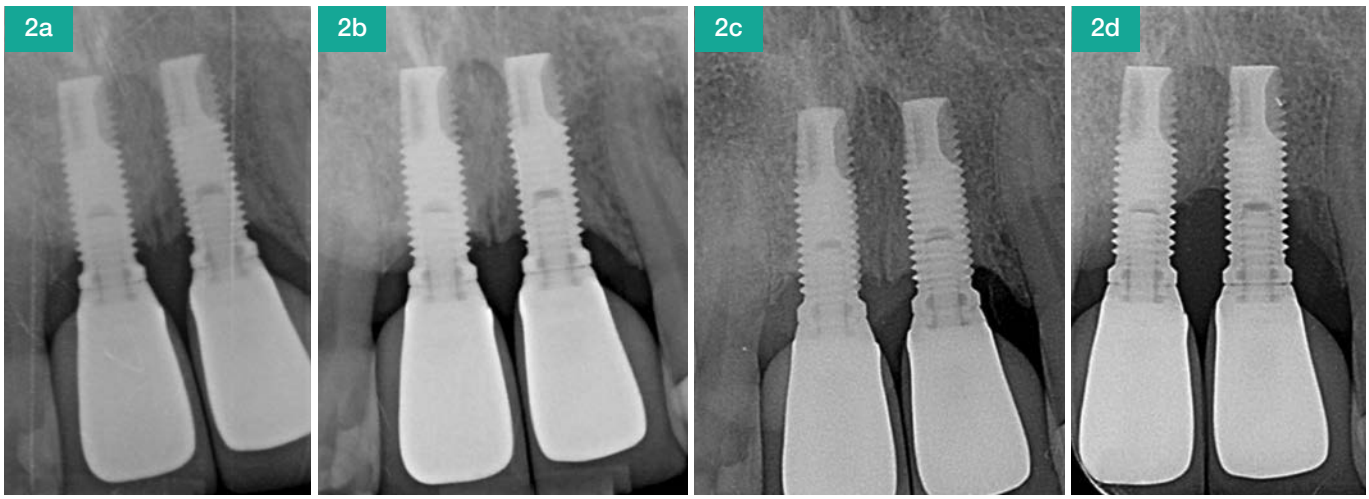
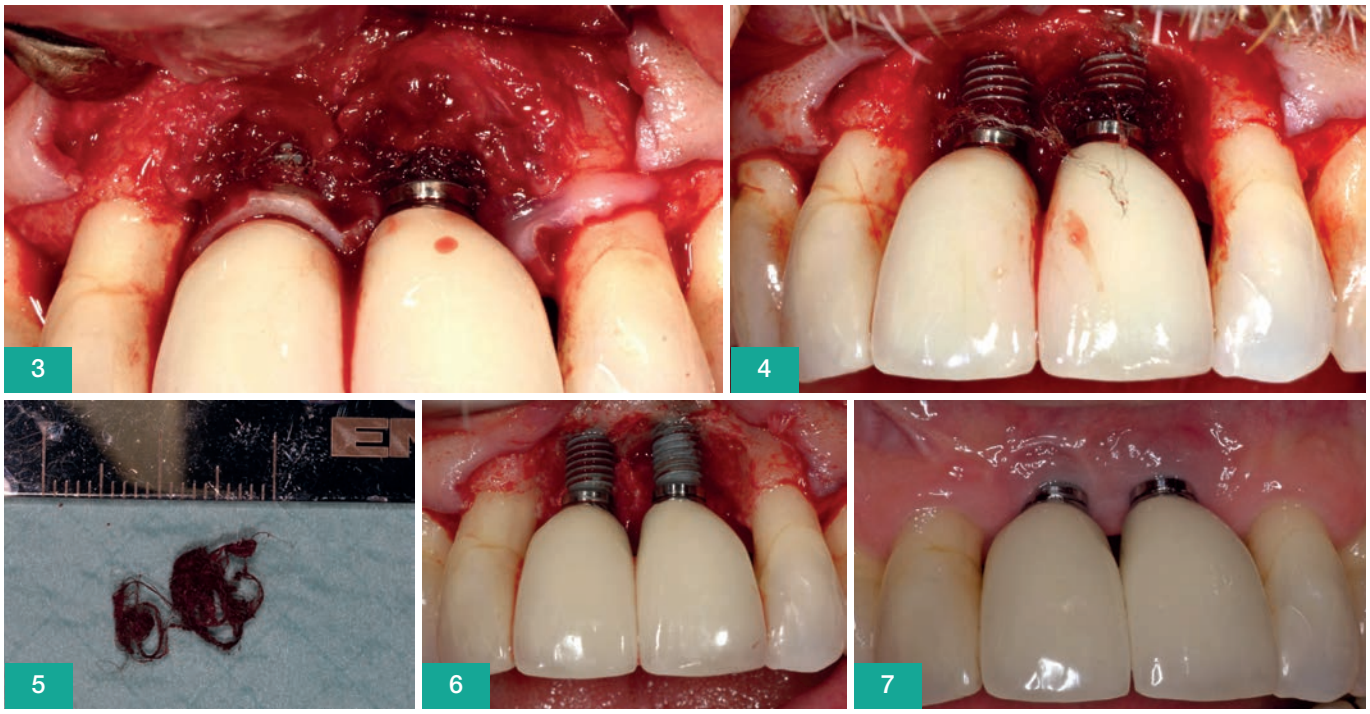


Figure 2a. A periapical radiograph taken 1 year after restoration which shows slight bone remodelling to the first/second implant threads.

Figure 2b. A periapical radiograph taken 9 years after restoration which shows relative stability of the marginal bone levels, compared to Figure 2a.

Figure 2c. A periapical radiograph taken 11 years after restoration showing a minor increase in marginal bone loss compared to Figure 2b.

Figure 2d. A periapical radiograph taken 13 years after restoration showing a marked increase in marginal bone loss, compared to the previous film taken two years earlier (Figure 2c).



Floss). He reported seeing his dentist and hygienist for maintenance care on a 9-monthly basis.

Upon clinical examination, the patient had a very high standard of oral hygiene and periodontal probing depths within a normal range. The implants at the 11 and 21 sites were Branemark Mk III TiUnite® fixtures, restored with cement-retained crowns. The peri-implant mucosa surrounding 11 and 21 was erythematous, and suppuration from the sulci was noted upon gentle finger pressure (Figure 1). Peri-implant probing depths were increased (4-9mm) with bleeding and suppuration on probing. A series of periapical radiographs taken at various time intervals over the preceding 14 years were supplied by the referring dentist (Figures 2a-d). These showed relative stability of the marginal peri-implant bone levels over time, but the most recent radiograph (Figure 2d) showed marked bone loss, involving up to 6 implant threads. The patient was diagnosed with peri-implantitis of the 11 and 21.

Surgical exploration and debridement of the implants was performed under local anaesthesia. Pre-operatively, the patient gave his consent for grafting of the bony defects using xenograft/allograft materials and/or removal of the implant threads (implantoplasty) if deemed appropriate at the time of surgery. Surgical access was made using submarginal incisions around the 11 and 21 and intrasulcular incisions extending to the distal line angles of 13 and 23. Full-thickness mucoperiosteal envelope flaps were raised on the labial and palatal aspects. Upon flap elevation, a trapped brown filamentous material was noted to be wrapped around the coronal aspect of both implants and associated with a large volume of inflamed granulation tissue (Figure 3). Upon removal of the granulation tissue and the inflamed soft tissue collar, the extent of this foreign material and the associated bony destruction was apparent (Figures 4 and 5). The fibrous fragments were subsequently removed and the implant surfaces were thoroughly debrided using PEEK-coated ultrasonic tips (EMS instrument PI), air abrasion (EMS Airflow), and sterile saline application. The resultant bony defect was judged to be unsuitable for guided bone regeneration due to the absence of supporting bony walls, and an implantoplasty was not performed (Figure 6). The flaps were apically repositioned and closed using resorbable monofilament sutures to the interdental papillae (5-0 Monofast, Omni). Standard post-operative instructions were given, which included advice to avoid brushing the treated area for 10 days. The patient was issued with chlorhexidine mouth rinse (Savacol 0.2%, Colgate) and ibuprofen for use in the post-operative period. He ceased using dental

Figure 3. A clinical photograph taken immediately after elevation of the labial envelope flap, showing granulation tissue associated with fibrous material around the implant collars.

Figure 4. An intra-operative photograph taken after removal of the granulation tissue, showing the retained fibrous material wrapped around the exposed coronal implant threads and the extent of peri-implant bone loss.

Figure 5. A clinical photograph of the fibrous debris removed from around the implants, which was presumed to be retained fibres of dental floss.

Figure 6. An intra-operative photograph taken after the removal of the retained foreign material and thorough chemo-mechanical debridement of the implant surfaces. The lack of labial and palatal bony walls meant that these sites were not suitable for guided bone regeneration.

Figure 7. A clinical photograph taken at follow-up 12 weeks post-operatively, showing a reduction in inflammation of the peri-implant mucosa and associated recession exposing the implant collars.

floss and began using interproximal brushes (TePe) 10 days post-operatively.

Healing proceeded uneventfully. Upon review 12 weeks later, the patient reported no bleeding upon brushing or unpleasant odour. The visible inflammation of the peri-implant mucosa had resolved, and there was a slight increase in recession (Figure 7). The peri-implant probing depths reduced from 4-9mm initially to 2-3mm post-operatively, with no bleeding or suppuration on probing. The patient remained on a six-monthly supportive peri-implant maintenance care programme with a hygienist. At a follow-up visit 22 months after surgical debridement, the peri-implant tissues remained healthy with no bleeding or suppuration on probing. A periapical radiograph (Figure 8) showed stabilisation of the peri-implant bone levels.

Discussion

The fibrous substance removed from the peri implant tissues during surgical debridement was presumed to be remnants of dental floss. The patient reported a history of diligent daily flossing using a cross-over technique, and an accumulation of trapped floss fibres within the peri-implant sulcus may have been responsible for the progressive bone loss that occurred after a period of relative stability (Figures 2a-2d). Similar cases have occasionally been reported in the literature.

van Velzen et al. (2016) documented a case series of 10 patients with peri-implantitis which persisted after non-surgical management. During surgical exploration, remnants of dental floss were identified and removed from the exposed roughened surfaces. At follow-up, a reduction in peri-implant probing depths was achieved for all implants, and all but one exhibited no bleeding on probing. The authors also undertook in vitro testing, which confirmed that rubbing waxed dental floss or spongy-type floss on the roughened surface of an implant left residual fibres and/or wax residue on the surface, while interdental brushes left no remnants (van Velzen et al. 2016). Montevecchi et al. (2016) reported a similar case where floss remnants were retrieved from around four implants exhibiting inflammation and bone loss using perioscopy. The inflammation subsequently resolved and the marginal bone levels remained stable after 6 years.

It has been proposed that the macromorphology of dental implants may tear floss fibres, leading to their retention within the peri-implant sulcus (Montevecchi et al. 2016; van Velzen et al. 2016). While the smooth implant collar is unlikely to damage floss, early bone remodelling or mild peri-implant bone loss may expose the implant threads and the moderately rough implant surface, promoting the retention of floss fragments. Poorly fitting prosthetic connections have also been implicated (Montevecchi et al. 2016). A recent in vitro study compared floss residues on implant surfaces after standardised flossing with spongy floss (Montevecchi et al. 2021). No floss residues were detected on implants mounted without thread exposure, while residues were detected on the majority of implants with exposed threads or a misfit between the implant and the abutment. In the present case, the implant prostheses appeared to fit well, but even prior to the progressive radiographic bone loss, physiological bone remodelling had exposed the first and second implant threads. The exposed threads and the microtexture of the moderately rough implant surface may have facilitated floss trapping. While flossing around smooth, well-fitting abutments and implants without bone loss may be a relatively safe and effective method of plaque control, the risk of floss retention appears to be higher around implants with exposed threads. Professional supportive peri-implant care is particularly important for the maintenance of implants with bone loss and/or poor prosthetic connections.

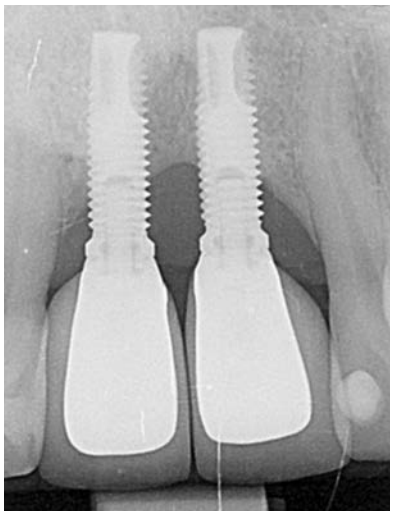


Figure 8. A post-operative periapical radiograph taken 22 months after surgical debridement, which shows stabilisation of the bone levels and an increase in bone density at the crest.

Commonly-used experimental models of peri-implantitis involve the application of ligatures around dental implants, which facilitate plaque accumulation, allowing inflammation and marginal bone loss to develop (Lindhe et al. 1992; Reinedahl et al. 2018). There are some similarities between these models and the possible mechanism of bone loss observed in the present case, whereby the retained floss fibres may have acted as ligatures by promoting the accumulation and retention of sub-mucosal plaque. Alternatively, according to the immunological theory proposed by Albrektsson et al. (2020), the retained fragments may have initiated a foreign body reaction, triggering an inflammatory response. Either way, it is likely that the floss remnants were a major predisposing factor to the observed peri-implantitis.

There is no standardised, evidence-based protocol for the management of peri-implantitis, which presents clinical challenges. Non-surgical therapy, while beneficial for peri-implant mucositis, has limited efficacy for the treatment of peri-implantitis (Renvert et al. 2008). Surgical debridement allows direct visualisation and decontamination of the implant surface and removal of inflamed granulation tissue. In this case, a surgical approach facilitated identification and complete removal

of the floss remnants. The similar cases reported in the literature demonstrated resolution after surgical treatment (van Velzen et al. 2016; Montevecchi et al. 2016).

Implants with roughened micro-surface structure may exhibit higher rates of peri-implantitis than those with smooth, machined surfaces (Polizzi et al. 2013). In addition, pre-clinical data suggests certain roughened implant surfaces, such as the TiUnite® surface, may predispose to more pronounced and rapidly progressive peri-implantitis (Albouy et al. 2008). These surfaces facilitate biofilm adherence and are challenging to thoroughly decontaminate. Implantoplasty, the mechanical smoothing of the implant threads and roughened implant surface, is sometimes used in combination with surgical debridement to treat peri-implantitis with good success (Lima et al., 2021). Implantoplasty was considered as an option for treatment in the present case, but once the retained floss fibres were identified, their contribution to the bone loss was clear, so the implant surface was not modified.

The present case and other case reports indicate that floss remnants caught within the peri-implant sulcus may predispose to peri-implantitis. It is important that oral hygiene advice is delivered to implant patients in a careful, individualised manner and they are reviewed to assess their skill and adherence. Monofilament floss may be less likely to tear than braided or spongy alternatives. Since implants with exposed threads or misfitting abutments may be at higher risk, clinicians may recommend alternatives such as interproximal brushes and/or oral irrigators for their maintenance (Montevecchi et al. 2021). There is a clear need for further investigation into the safety and efficacy of the various tools available for daily implant care.

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News from the School

Scientific Editor Professor Jonathan Broadbent has been awarded the Distinguished Scientist Award from the International Association for Dental Research (IADR). The IADR was founded in 1919 and has over 10,000 members worldwide involved in dental, oral and craniofacial research. The award was made for Jonathan's "meritorious research in epidemiology and public health". He is involved in many projects within and outside the School of Dentistry, the most well-known being the 'Dunedin Study' where he currently leads the dental component investigating the life course of a large cohort of people who are now aged in their 50s. Professor Broadbent has made important contributions to understanding oral health conditions, their risk factors, and their implications for general health.