

Origins and Recovery from Superinfections and Soft Tissue Necrosis

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Abstract

The aim of the study was to gather further information regarding the reasons for superinfections and soft tissue necrosis, and to compare them with common gingivitis and periodontitis. A further aim is to see if there are differences in the recovery from these diseases which all are associated with microorganisms. The information was gathered retrospectively from 250 patients and altogether 4022 visits to a specialist. The material was chosen randomly according to the first letter of the patient's surname, among the 250 patients that were selected. The treatments of 155 patients took place between 1987-2016. The treatment of some patients had started earlier, but the controls had been continued for a long time after 1987. The examinations have been clinical, microbiological, and based on anamnesis, roentgenograms and histopathological examinations. The follow-up time was between 1 to 40 years. The patients who had periodontitis or superinfection were treated in the same way. Antibiotic therapy was prescribed for recurring infections, or if the patient had a difficult disease. In periodontal-endodontic infections, root canals were treated. Periapical lesions were surgically treated. Both periodontitis and superinfections occurred predominantly in the age group between 41 and 60 years. Narcotic- or snuff-addicts were not included in the material, nor were alcoholics, although 6 patients did report moderate use of alcohol. Diseases and other infections had been treated both in patients with periodontitis and in the superinfection group. Oral symptoms were the same, except that the superinfections were violent. The difference in diagnosis was based on the anamnestic information of the antibiotics which induced the acute reaction, on the clinical and microbiological studies. The patients had received 12 different antibiotics, from which 10 induced superinfection. Extraction of teeth did not prevent normal infection, nor superinfection. The infections appeared as ulcers, white coverings or the flush of mucosa, and if the teeth remained, gingival pockets were purulent. The found micro-organisms were yeasts, mould, bacteria, also periodontopathogens. In the superinfection group, some

multiply resistant organisms were found. The prognosis of the treatment was good both for patients with periodontitis and superinfection. Flap necrosis is a local, rare surgical complication, in which one factor is superinfection. Incorrect treatment of soft tissue did not lead to flap necrosis in this study. Superinfection is a different disease to periodontitis or gingivitis, because it is induced by antibiotics, and it is linked with multiply resistant microorganisms that are not sensitive to the antibiotics used. Normal periodontal, surgical and endodontic treatments are suitable for patients with periodontal-endodontic problems or superinfection. Superinfection can be very severe, locally or in the whole periodontium, if the infection is bacterial. When the infection was due to yeasts or moulds, local infection was not found. The recovery prognosis is good both in periodontitis and in superinfection. The connection to other diseases is not clear. Cardiovascular diseases, rheumatoid arthritis, diabetes mellitus, accidents and other infections were in anamnesis both in patients with periodontitis and in patients with superinfection. Patients with urinary tract infections who were prescribed antibiotic treatments were more prone to superinfection. Anyone can contract a superinfection. In a healthy gingival, it appears as ulcers, coverings, flushing or gingival bleeding, whereas in patients with periodontitis, the superinfection is mainly purulent. Endodontic superinfection is also possible.

Keywords

Superinfection, Flap Necrosis, Recovery of Periodontitis and Superinfection

1. Introduction

Superinfections are not ordinary gingivitis or periodontitis even though microorganisms are found in both, and in a healthy mouth as well [1] [2] [3] [4] [5]. Superinfection is defined as a condition where the administration of an antibiotic is associated with a prolongation or exacerbation of the infection or with clinical evidence of a new infection [6] [7]. For this acute disease, there are two main explanations: the antibiotic eliminates competing microorganisms or enables the growth of microorganisms that cause the superinfection [8]. Inactivation of antibiotics and dissemination of resistant genes can be in question too [9]. Microbes resistant to antibiotics can transfer genetic material to sensitive bacteria which then become resistant [10]. Antibiotics are primarily directed to microorganisms, but they can affect the host on an organic, cellular or molecular level [11]. Direct contamination is also possible, for example in hospital infections. Hospitals have an important role in the spreading of resistant organisms and in the development of resistance [12] [13]. Antibiotics prescribed by general practitioners cover about 90% of the total use [14] [15] [16].

In superinfection, microorganisms acquire resistance during the antibiotic treatment, or are already resistant to the antibiotics used and grow when sensitive strains are eliminated [17] [18] [19].

Suprainfection and superinfection are major microbiological and clinical problems and are known to occur in intestinal and oral mucosae, in skin, lungs and periodontium [20]-[25].

Antimicrobial resistance is increasing in connection with the use of beta-lactamases. In the mouth, particularly *Prevotella* sp. are bacteria that produce beta-lactamase [26]-[31]. Antibiotics should not be used in normal periodontal infection [32].

Complications caused by superinfections are known in oral surgery. Bacteraemia must also be taken into consideration [33] [34] [35]. Endodontic superinfections are also possible, because they can be linked to resistant microorganisms [25] [36] [37]. As antibiotics are also needed, it is even more important to take samples of difficult infections and to examine sensitivities in order to avoid unnecessary medications [38]. Empiric medications have to be used in some cases. Oral microflora is the main reason for serious symptoms in which the mortality rate is 15% - 45% even when appropriate medication has been used. The worst complication is infectious endocarditis [39] [40].

Soft tissue necrosis is a local, rare complication of periodontal surgery, where the soft tissue disintegrates (although the surgical operation has been carried out correctly). Many reasons can lie in the background, such as accidents or other diseases, but resistant bacteria and superinfection, linked to antibiotic treatments, are important factors. Osteomyelitis has been found too [36].

It has been known for penicillin to change the flora as soon as it became part of clinical use [41].

Penicillin resistance is also known in acute periodontitis related to subgingival microflora [42]. Many other antibiotics are also known to have a connection to superinfections [21] [43] [44]. There are also known bacteria that are resistant to methicillin and vancomycin, and they are a big problem [13] [14]. Resistance to trimethoprim and sulphonamide has been also identified in previous studies [45]. Peroral amoxicillin-clavulanic acid can cause an increase in gastrointestinal-resistant enterobacteria [46] [47].

Odontogenic infections and liberal use of antibiotics can also mask the symptoms and delay necessary surgical treatments [48]. In addition to superinfection induced by antibiotics [15] [21], adverse drug interactions must be taken into consideration, as they can reduce the effect [28] [49] [50].

The aims of this retrospective study are:

- To gather more information about other possible background factors in addition to antibiotics in periodontal superinfections and in soft tissue necrosis,
- To compare background factors between the group in which patients had periodontitis and the group in which patients had superinfection or flap necrosis,
- To see the prognosis and recovery for treatments in both groups,
- To follow which antibiotics act as inducing factors in the superinfection and which are effective,
- To see which microorganisms have been found in superinfection.

2. Material and Methods

Knowledge has been examined by looking at 250 patient files, involving a total of 4022 treatments. All clinical examinations and treatments or operations were done by the same clinical specialist. Files were chosen randomly by using the first letter of their surnames. The treatment visits of 155 patients were between the years 1987-2016. The rest of the information comes from patients whose treatment first started before 1987, but their treatment continued after that year. 183 patients came from Tampere and nearby regions. Single complication cases came from 67 different regions in Finland. 157 of patients were female and 93 men.

The main reason why patients came to the clinic was a dentist's referral (in 120 cases), because the patient had acute or chronic gingivitis or periodontitis, or superinfection was suspected. Two came because a nurse had told them to do so for similar reasons. Some of the patients came of their own decision to the specialist. Previously in Finland, periodontal superinfection was called an acute reaction induced by antibiotic therapy. Other reasons for coming for treatment were accidents, tooth fractures, pain, dysfunction of maxillary joint, control visits, problems in the healing process after the extraction of the tooth at another clinic. At worst, the patient's jaws kept getting dislocated unless they had a scarf tied around their head. The alveolar bone had been resorbed after the extraction of the teeth decades ago. In all, 27 of the patients were smokers, but only one of them had superinfection. The other 26 had periodontitis or gingivitis. All of them had smoked from 2 to 30 cigarettes per day over the course of 6-60 years. Only 6 patients mentioned that they either rarely consume alcohol or consume it a couple times a month. There is no information about users of narcotics or snuffs.

Statistical methods: The differences between the groups were tested by Chi-squared test.

All clinical examinations and treatments or operations were done by the same specialist using the same methods as outlined in her dissertation. Dental plaque, gingivitis and dental calculus were recorded [1] [21] [51] [52]. The gingival pockets of all four surfaces were measured and registered from the gingival margin to the depth of the pocket [21] [53]. The degree of mobility was estimated from 1 to 3 [22] [53] [54]. Caries was registered clinically [55]. Oral and systemic symptoms and diseases were registered too. Photographs were taken, if possible, from gingiva and/or from the mouth when the patient had a serious infection,

Figure 1.

Some patients had orthopantomograms or roentgenograms produced by the intraoral periapical technique already with them and the rest had them taken at the examination. Some patients also had a so-called "community periodontal index of treatment needs" (CPITN) produced by their dentist, but a CPITN is not enough to tell the degree of gingival infection [56] [57]. The attached gingiva was also evaluated.



Figure 1. Superinfection.

Not all patients wanted all of the available examinations or treatments. Microbiological samples were taken from gingival pockets with a sampling needle or with a paper stick, and put into a sampling tube, if the patient agreed to it. Samples were taken from the surface of gingiva or mucosa by wiping with a wadded stick. When the samples were taken with the paper stick, the plastic tube in the gingival pocket was not used. The samples were examined in the laboratories of Turku University Hospital (TYKS), of Helsinki University Hospital (HUS), of Plus Terveys, and of Tampere University (Department of Biomedical Sciences). A few were examined in Sweden at Odontologiska Kliniken Avd Oral Microbiologi, Göteborg, and at MIP in Germany.

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3. Results

Most of the patients who had periodontitis or superinfection were in the age group between 41 and 60 years old (**Table 1**). The common control time was under 5 years, but there were also controls of ten years (**Table 2**).

Total amount of patients was 250 of which 22 with superinfection and 228 with other gum and mouth diseases, mainly periodontitis and gingivitis.

The reaction due to local anesthesia included trembling, fainting, pulsating of heart, nausea and whitening of the skin. These symptoms were associated with the adrenalin of the anesthetic drug. One ampoule was enough in some cases. Patients' own evaluations of their current health condition were good in 106 cases, medium in 5, bad in 9 and unstable in 2. The rest of them did not give an opinion. Of the patients who had periodontitis or gingivitis, 33 reported no diseases. In the superinfection group, one did say that they are healthy, although in the gingiva a bad, purulent periodontal superinfection could be seen (**Table 3**).

Figure 1 presents a case of a patient who had flap necrosis and many superinfections due to *Candida* sp. in the anamnesis. She was 63 years old. The dentist had sent her because of difficult periodontitis: one tooth had already been

Table 1. Age groups of patients.

Age	Number of patients
Under 20	8
20 - 40	66
41 - 60	104
61 - 80	57
over 80	15

Table 2. Tracking time.

Age	Number of patients
1 - 5	174
6 - 10	47
11 - 20	20
21 - 30	8
31 - 40	1

Table 3. Systemic diseases of patients without superinfections (group 1, 228 total) and with superinfection and soft tissue soft tissue necrosis (group 2, 22 patients).

Disease	Group 1 No superinfection	Group 2 Superinfection or soft tissue necrosis		
Cardiovascular diseases	52	7	p = 0.34 ns	
Asthma	9	0		
Diseases of the lungs	7	0		
Allergy to penicillin	10	1		
Allergy to sulphonamide	10	0		
Allergy to other antibiotics	9	0		
Allergy to antibiotics and other medicines	11	0		
Allergies to foods	6	0		
Allergies to pollen, hay, flowers	5	0		
Allergy to nickel and copper	4	0		
Allergy to gold nitrite	1	0		
Allergy to multiple substances	5	0		
Osteoporosis	4	0		
Rheumatic diseases	25	3	p = 0.70 ns	
Diseases of the skin	15	2	p = 0.65 ns	
Diabetes	7	1		
Diseases of the eyes or ears	9	3	p = 0.042	

Continued

Sinusitis or infection of frontal sinus	6	5	P < 0.0001 s
Infections of urinary tracts	4	9	P < 0.0001 s
Other infections	0	4	
Diseases of the liver or of the kidneys	2	0	
Neurological disorders	11	2	
Mental illnesses	4	0	
Cancer	7	0*	
Hormonal diseases	16	2	
Blood diseases	4	0	
Accidents	19	4	
Gastric or intestinal ulcer	2	0	
Mole fever	1	0	
Reactions from local anaesthetic	6	0	

*The cancer of the patient who had superinfection recovered. Therefore, cancer is 0 in **Table 4**.

lost. There was no caries, but deep gingival pockets and the remains of one root were found. According to the anamnesis, “penicillin had caused yeast infections”, and she had been operated on for breast cancer 4 years previously, for which she had also received radiation treatment. She got a flap-operation and resection of a tooth whose gingival pocket extended to the apex of the tooth. The patient was given pain-killers (Ponstan® 250 mg XXX, 2 tablets 3 times per day, and V-Pen mega XV 1 tablet 3 times per day). In the operation, neither pus nor granulation tissue could be seen in the apical area, only an empty, dry cavity in the bone. After 3 days, an itchy rash appeared on the hands and feet of the patient. This was an allergic reaction due to the use of penicillin, which was subsequently discontinued. 7 days after the operation, the gingiva and mucosa were in necrosis labially in the region of one resected tooth.

As **Figure 1** shows, the superinfections have not disappeared. The patient had gotten Kefalex® 750 mg XIV 1x2. After it appeared purulent endodontic and periodontal superinfection. Suppuration lasted half a year. The patient did not have caries. The patient had visited her dentist regularly. Enterobacteria sp (sensitive to ampicillin, doximycin, ciprofloxacin) and anaerobic gram-negative rods (resistant to penicillin, sensitive to metronidazole and doxycycline) were found in the pus. Later also *Actinomyces Turicans* (resistant to metronidazole) was found.

After 11 days, the affected area had recovered. The control period was 2 years and 4 months including root scaling and prophylactic treatments. In this time, the patient had suffered from infection due to *Candida* sp., and it had been treated with Pimafucin. The controls were ceased when the gingiva was in good condition. The diagnoses were periodontitis complex, periodontitis chronica, al-

lergy to penicillin, periodontal and endodontic superinfection and soft tissue necrosis. She also received the flap operations of the upper chin, and recovery was normal and without flap necrosis. There was no record of accidents. Superinfection due to *Candida* sp had extended from the mouth into the skin. The diagnosis was cheilitis.

Figure 2 and **Figure 3** show another case of flap necrosis due to periodontal and periapical infection. There was no caries, but gangrena pulpae. The labial bone of the tooth had lost totally before. After endodontic and surgical treatment, the flap was necrotic. The bare root surface so broad that the circulation did not develop. And the labial giniva and mucosa were necrotic. It healed, but the cosmetic result was not good. The patient was a thirty-year-old man. And he had gotten V-Pen mega® XV 1x3. In the surgery could be seen that the whole tooth was without bone.

In the study, the same patient could suffer from many oral and systemic diseases simultaneously (**Table 4** and **Table 5**). Superinfection can occur in the same patient multiple times and it is usually serious.



Figure 2. X-ray image of periapical situation before surgery.



Figure 3. Flap necrosis due to periodontal and periapical infection.

Table 4. Oral diagnosis of patients without superinfection (228 patients in total).

Diagnosis	Number of patients
Gingivitis and/or periodontitis chronica	139
Gingivitis and/or periodontitis/or pericoronitis acuta	80 (purulent)
Periodontitis juvenilis	4
Periodontitis complex or profunda	59
Gingival overgrowth	19
The attached gingiva is missing	4
Aphthous stomatitis	9
Lichen or leucoplacia or hyperceratosis	9
Frenulum anomale or sulcus near to the margin of gingiva	17
Granuloma pyogenes or epulis or fibroma	7
Cheilitis	3
Herpes infection, primary or labial	6
Caries, splitting or fracture of the tooth	80
Enamel hypoplasia	7
External resorption in the root surface of the tooth	1
Perforation in the root of the tooth associated to prosthetic construction	2
Detachment of tooth or damage in accident	4
Pulpitis acuta/pulpanecrosis	15
Gangrena pulpaee	27
Dysfunction/orthodontic problems	52
Cysta labialis	1
Periapical diseases	19
Xerostomi	4

Table 5. Oral diagnosis of patients with superinfection and soft tissue necrosis (22 patients in total).

Diagnosis	Number of patients
Abscessus periodontalis, 1 or many abscesses suppuration of gingival pockets	10 (purulent)
Abscessus periodontalis and ulceratio oralis	2 (purulent)
Abscessus periodontalis, ulce ratio oralis and gangrena pulpaee	2 (purulent)
Only ulcerations, white coverings and/or reddiness (superinfection due to yeasts or moulds)	6
Suppurative periapical superinfection and fistula	1 (purulent)
Soft tissue necrosis after flap resection operation	1

In the superinfection group, 15 of 22 patients also had periodontitis chronica or acuta in the background, and 2 of the 22 patients had the periapical infection of the tooth in addition to superinfection.

Patients had also had a significant number (747) of surgical procedures during tracking period (**Table 6**) where only 22 had flap necrosis. This indicates that flap necrosis does not originate from type of surgical operation.

In addition to these, there were treatments of dysfunction, first aid, treatments of caries, controls, prophylaxis etc. “Tooth treated in the hand” means that the tooth had come off because of an accident or periodontitis, but it remained available during the operation. The tooth was cleaned and scaled by hand with curettes, put into the socket and attached with periodontal fastenings in connection with the flap operation.

Bone grafts have been Biocoral®, Frialite®, Osprovit® or RTR® [58]. Barrier membranes have been Gore-Resolut®, Vicryl® or Guidor®, enamel matrix derivative was Emdo-gain® [58] [59] [60]. Elyzol®, a local antibiotic metronidazole, was used in the gingival pockets in connection with surgery or curettage. The most common cause of extractions was fractures or the remainder root of the tooth. Surgical and other periodontal treatments have been made following the same principles in every case, whether the patient had periodontitis or superinfection.

Table 6. Procedures completed to all patients during tracking period.

Description of procedure	Number of patients
Flap operations	330
Flap operations, in which bone grafts were used	26
Flap operations, in which membranes were used	16
Flap operations, in which Emdogain® was used	11
Flap operations, in which Elyzol® was used	8
Gingival graft operations	14
Flap operations, in which the tooth was treated in the hand	5
Gingivoplasty surgery or gingivoectomy	183
Plastic surgery of frenulum, sulcus or tuber	20
Resection, hemisection or radectomy operations	39
Normal extractions of teeth	78
Difficult extractions of teeth in surgery	13
Other operations (e.g. removing of fibroma molle, epulis or granuloma pyogenicum)	4
SURGICAL OPERATIONS IN ALL	747
Curettages	540
Depurations	1842

Is periodontal treatment then worthwhile? It can be illustrated with one example from the study material. When nearly every tooth of the patient was without bone support, the teeth were preserved in the mouth for 12 years (**Figure 3**). The treatment was truly worthwhile. Implants were not possible at the beginning and implants cannot prevent infections. The situation after this period is unknown. We cannot know from the roentgen films whether the infection is a superinfection or another periodontal disease. Marginal alveolar bone and different lesions in the bone are diagnosable [61] [62]. From the anamnesis, it could not be told why the periodontitis was so bad. The gall and appendix had been removed and the patient was allergic to metal. As previous periodontal treatments and possible drugs were unknown, the diagnosis was periodontitis profunda in the whole mouth.

Although the preservation of teeth of the elderly is not always of benefit, (Ketola-Kinnula T.17.11.2012 at Finnish Dentists Days), and although removable dentures used to be fitted quite often [63], it must be remembered that extractions of teeth cannot prevent infections. In this study, a patient who had removable dentures and had received antibiotics, had a very serious oral superinfection in the mouth. Clinically, it resembled a fungal superinfection. However, a coliform rod shaped bacterium +++ was found from the samples, a bacterium which was resistant to Amox + Kla, resistant to Ampicillin and intermediate to cefuroxime. *C. albicans* could only be found at +. In this case, other diseases can aggravate the infection in the mouth; the patient had diabetes, lung disease and high blood pressure.

From the gingival pocket of the patient, who had received many treatments with cephalosporin during the last year, resistant *Parvimonas micra* was found. Abscesses appeared in the gingiva of the whole mouth in different regions. The last treatment had been Kefexin and Flagyl. It was a clinically purulent periodontal superinfection. In the pocket Propionibacter acnes were also present, resistant to metronidazole, and *C. albicans*++, sensitive to fluconazole. The patient had periodontitis before superinfection.

It is difficult to know which antibiotics are effective without samples. The patient had been prescribed Clasid® 500 mg VII, 1x per day, due to sinusitis. A prophylactic dose of Flagyl and Amorion made the situation worse, and periodontal and periapical superinfection could be seen in the mouth. However, with periodontal and endodontic treatments, the teeth remained in the mouth for 31 years, which was the control time.

The patients in the study had received a total of 12 different antibiotics due to different infections. Of these 12 antibiotics, 10 induced superinfection. So far, ciprofloxacin and erythromycin have induced the lowest number of superinfections. Penicillin and erythromycin reduce plaque and erythromycin reduces gingivitis. When penicillin-induced acute purulent infection, plaque, gingivitis, depths of gingival pockets and mobilities of the teeth increased. Untreated periodontitis is an important factor. In the blind study, 42% of patients appeared to have acute periodontitis when they had taken penicillin [53]. Antibiotics do not

compensate periodontal treatments. They are supporting treatments and we need them in many situations [64] [65].

Deep caries is a risk of complication, but in this study it was mainly in control. Good homecare and mechanical dental treatment are important: A loose tooth that had also been the support of a denture, was kept in the mouth for 29 years with surgical and other periodontal and endodontic treatments. In the flap-operation, hydroxyapatite and Osprovit was used; In 2016, 29 years after the initial treatment and periodontitis, the situation was very good.

However, superinfection can also appear in the healthy gingiva and mouth. One patient had been given penicillin due to an infection in the bed of the nail. Penicillin did not help and the next drug was sulphonamide. In the gingiva and oral mucosa, a new superinfection, gingivostomatitis, could be seen, although oral hygiene was good.

When antibiotics are prescribed without microbiological studies, it is difficult to know the level of resistance of the bacteria (**Table 7** and **Table 8**). Multi-resistant bacteria, methicillin resistant *Staphylococcus aureus* (MRSA), *Proteus* sp, *Klebsiella* sp, *Enterobacter* sp, *Pseudomonas* sp, *E. coli*, *Parvimonas micra*, and *Propionibacter acnes* have been found in gingival pockets and oral mucosa of the superinfection patients in this study. Many of the same multi-resistant organisms were connected to the use of several antibiotics already in another study [21]. Previously only penicillin was suspected to be an inducing factor of superinfection.

Table 7. Albican found from oral mucosa.

Albican type	Resistance
Clotrimazol	R
Flukosytocin	S
Itrakonazol	R
Ketokonazol	R
Miconazol	R
Amphotericin B	S
Fluconazol	R
Nystatin	S

Table 8. Klebsiella sp found from gingial pocket.

Diagnosis	Resistance
Penicillin	R
Amoxicillin	R
Doxycyclin	S
Erythromycin	R
Metronidazol	R
Sulfonamide+ trimetoprim	S

In this study's material, periodontopathogens were not essential inducers of superinfections.

The patient in **Table 7** had in the gingival pocket Aa 0%, Bg 0%, black-pigment. *Bacteroides* 5.2%. Both patients in **Table 7** (64-year-old woman) and **Table 8** (32-year-old man) had superinfection and both recovered. Purulent superinfections were local, one or a few abscesses, or in the whole gingiva. In one patient, abscesses appeared after antibiotic treatment in a region where periodontitis was not yet being treated. The treated regions remained healthy. Fungal superinfections were not local. In cases of cheilitis, yeasts could be found from the mucosa of mouth too. The infections caused by yeasts and moulds need to be treated with mycotic agents [66].

Although so-called "teeth treated in hand" without bone support could hold in the mouth for decades, it is now possible to treat them with easier methods. Implants are good inventions, although not an end in itself. Usual scalings of root surfaces are still important due to biofilm, and flap-operations in deep gingival pockets [53] [55]. If the gingival pocket is near the apical region of the tooth, the endodontic treatment is necessary even if the tooth is vital.

4. Discussion

In the light of this study, anybody can get a superinfection induced by an antibiotic, even in a healthy mouth, at least after several antibiotic treatments. In untreated periodontitis, superinfection is mainly purulent. In healthy gingiva or if the patient is toothless, the superinfection is ulcerative, and in the mucosa white covers or redness can be seen. This has been shown earlier [21]. Direct contamination is also possible, especially in hospital infections [12]. The world is not sterile, and micro-organisms surround us, although good hygiene does have a positive effect. Are superinfections possible without antibiotics? The definition of superinfection shows that it is not possible, although symptoms can look similar in a slight disease [67] [68]. In addition, in this study, all superinfection patients had been treated with antibiotics. If the patient has an infection without antibiotics, it is not a superinfection. But it does not mean that we cannot use antibiotics. Some diseases can require antibiotic treatment, but effective drugs should be found. It is useless to treat viral infections with antibiotics. Bacteria, yeasts and moulds can be found in common oral infections, in a healthy mouth and in cases of superinfection. The difference is that organisms of the superinfection are multi-resistant or resistant to the antibiotic used. Both periodontitis and superinfection are microbiological diseases.

Other diseases and poor defensive ability can increase susceptibility to infections [69] [70]. In this study, the patients with periodontitis had many diseases (**Table 3**), and only urinal tract infections could be seen more in the superinfection group (**Table 4**). One might think that these infections are often difficult to treat and that the patient must receive many antibiotic treatments. Scientists are not unanimous about the periodontal-systemic connection, such as between pe-

riodontitis and diseases of heart-blood vessels, respiratory organs, diabetes and osteoporosis. Arterial plaque has been thought of as being important factor in cardiovascular diseases and oral health is better after the treatment of osteoporosis. Aspirations pneumonia is connected with anaerobic and aerobic bacteria in the mouth. In diabetes, both mechanical and systemic antibiotic treatments give better periodontal status and glycaemic control [71].

According to this study, necrosis in soft tissue was not caused by the method of operation. The same has been shown earlier [23]. Microbiological studies are also important in this surgical, local complication. If there is bone left, circulation can develop, and the necrotic soft tissue can heal. The observation that the reason did not stem from the operation nor in the method is supported by the fact that the study involved 4022 treatments, 3129 periodontal measures, of which 747 were surgical operations, but only 1 flap necrosis, in which an allergy did also occur in reaction to the antibiotic used.

In deep gingival pockets, there is a risk that micro-organisms are reached via the apical region of the tooth into the root canal, or vice versa [72] [73] [74]. Gangrena pulpae should be prevented with endodontic treatment, even though the tooth is vital.

5. Conclusions

Superinfection is a different disease compared with gingivitis or periodontitis. The diagnosis should be supported by anamnesis, clinical exams and microbiological studies. Roentgenograms and samples of tissue (PAD) do not help with diagnosis of the superinfection. They show the difficulty of the infection and other possible reasons for the acute situation. The bite was not an important factor in either infection group. Neither alcohol, snuff nor narcotic materials were underlying causes. Smoking was not causal in superinfection but could be for periodontitis.

The same patient can get a superinfection many times as well as the usual periodontitis. In both groups, there were many other diseases, but their significance as underlying causes needs further study. Endodontic-periodontal superinfection is also possible. Serious diseases must be taken into consideration in dental treatment. It is fair to say that common diseases can make oral and other untreated infections worse. Microbiological tests are important, because it is impossible to know which antibiotic is effective. The drug that has induced the acute reaction should not be used. Many antibiotics can induce periodontal or oral superinfection, in which yeasts, moulds or bacteria resistant to the antibiotic used, often multi-resistant, have been found. Bacterial superinfection can be local or may affect the whole gingiva. Fungal superinfections are not local and require antifungal medicine. Anyone can catch a superinfection, even in a healthy mouth, but periodontitis is an important background factor in purulent superinfection. Extractions of teeth or use of implants do not prevent superinfections. The symptoms are the same for periodontitis, gingivitis and for superin-

fection; abscesses, ulcers, bleeding, white coverings, but they are usually more serious in superinfections.

A patient who has periodontitis, superinfection or soft tissue necrosis (local surgical complication) does usually heal. We can prevent periodontitis, but we cannot entirely prevent superinfections, because we need antibiotics in many situations. The use of antibiotics develops the resistance of organisms. The resistance has been found, although the use of antibiotics is based on current treatment references. Antibiotics are not an alternative to normal periodontal treatment, instead they support one another.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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