



Oral infections, a mirror of our overall health condition: An overview

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Abstract

Oral infections are infections that occur in or around the mouth and are caused by Bacteria and viruses. Oral infections are very common and may be a sign of an illness involving other parts of the body. Although most of these infections can be controlled by oral hygiene measures, these infections are directly related to the immunity and health status of an individual. Keeping these main health issues in mind, the common oral infections like tooth cavities, cold sores, oral thrush, periodontal disease, etc have been described here. The main factors affecting these infections have been listed here. Preventive measures available for these disease conditions and therapeutic treatment recommended for each type of infection including new delivery systems are discussed in this article. With a general awareness about these infections, proper oral hygiene and medical attention the increased prevalence of the oral infections can be controlled and overall health of an individual can be improved.

Key-Words: Oral, Health, Infection

Introduction

Oral infections are very common. Tooth decay is the second most common infectious condition, after the common cold [1]. More than 47% people in the USA are affected by problems related to oral infections [2]. There are many mouth infection problems, ranging from embarrassment due to bad breath on one hand to life threatening diseases like oral cancer on the other hand. However, some simple hygiene measures, like brushing teeth after eating, flossing and a regular check-up can help prevent cavities, gum disease and other such oral problems [1, 3].

An expert can take one look at our open mouth and get a good idea of our overall problems. The oral cavity, tongue, teeth and gums speak volumes about our health. Oral health should not be taken for granted as it is an essential part of our everyday lives. Good oral health enables us to eat, taste, touch, smell, speak and also express our emotions through facial expressions [3].

Like many areas of the body, our mouth is packed with mostly harmless bacteria. Normally the body's natural defenses and good oral health care keeps these bacteria under control. However, without proper oral hygiene, bacteria can reach levels that might lead to oral infections, such as tooth decay and gum disease.

Many oral infections are not contagious because bacteria that exist naturally in every person's mouth cause them. However, others like cold sores are contagious and spread through contact with fluid from an infected person's mouth [3,4]

Inspecting the tongue of a person helps an expert to quickly assess whether he or she is healthy or not. In less healthy people, the tongue is often coated with a whitish or yellowish deposit having a fur-like appearance. This may be caused by bacteria, viruses or a fungal infection ('thrush') growing on the tongue, which may be due to inadequate oral hygiene. Up to 50% of people who are HIV-positive have fungal, bacterial or viral infections in the mouth, which often occur early in the course of HIV infection. In a terminally ill patient, mouth infections such as thrush are very common as the person approaches closer to death. [5]

Some warning signs of oral infections are [1]:

- Bad breath or bad taste that won't go away
- Red or swollen gums
- Tender or bleeding gums
- Painful chewing
- Loose teeth
- Sensitive teeth
- Gums that have pulled away from your teeth
- Any change in the way your teeth fit together when you bite

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- Any change in the fit of partial dentures

The present study aims at highlighting the common oral problems which can seriously affect the quality of our life.

Types of mouth infections and oral lesions

These may be swellings, spots or sores on our mouth, lips or tongue. They can be painful, unsightly and can interfere with our eating and speaking. Any mouth sore that persists for a week or more should be examined by a doctor and tests performed to determine the underlying cause, such as diabetes, cancer and HIV.[4,5,6,7]

Although there are numerous types of mouth sores and disorders, the most common are :

Cavities: Dental caries or tooth decay and cavities, are small holes formed by destruction of the hard enamel of a tooth. Tooth decay occurs in about 80% children and teens and is the leading cause of tooth loss in younger people. Bacteria that live in the mouth, especially certain kinds of streptococcus, cause tooth decay. The bacteria change sweet and starchy foods, into acid, which eats away at the enamel of teeth. The acid, bacteria, and bits of food in the mouth combine into a thin film known as plaque A person with dental caries may experience pain or sensitivity to hot, cold and sweet food in the affected tooth. If left untreated, caries can lead to long-term tooth sensitivity, abscesses, weakened teeth that can break easily, and even tooth loss [6,7,8].

Canker sores: These are small white swellings or sores which are surrounded by an area of redness. However, they are not contagious. Canker sores occur inside the mouth and may recur at frequent intervals. They can be minor (small), major (larger) or herpetiform (multiple, in groups or clusters). Although the exact cause is unknown, some experts believe that weak immune system, heredity, bacteria, viruses, factors such as stress, trauma, allergies, cigarette smoking, and iron or folic acid, Vitamin B deficiencies, may also cause these sores [6,7, 9,10].

Herpangina: It is an infection causing painful sores on the roof of the mouth, the tonsils, or the inside of the cheeks. The lesions start as small bumps but become whitish sores with a red border. Herpangina usually is caused by coxsackie virus, which also causes hand, foot, and mouth disease; in which blisters are found on the palms and the soles as well. Patient may have a fever, sore throat, and headache 1-2 days prior to blister formation. It affects young children, mostly in summer and is difficult to prevent [5,6].

Herpes or Cold sores: They are also called **fever blisters** or **herpes labialis**. They are groups of painful, fluid-filled blisters present around the lips, under the

nose or around the chin. Cold sores are usually caused by herpes simplex virus, type 1 and are very contagious. Once a person is infected, the virus stays in the body, occasionally causing recurrent attacks. For some people, however, the virus remains inactive. [4,7,9,10]

Burning, tingling, or itching may occur a day or two before a small, sometimes painful blister appears on the gums, lips, inside of the mouth, or around the mouth. The blister is filled with clear or yellowish fluid. Shortly after it forms, the sore crusts over, and the crust eventually falls off. Sometimes a person also develops a mild fever or feels ill.[4,9]



**Fig. 1: Mouth infections a) Cold Sores
b) Canker**

Leukoplakia: This looks like a thick, whitish patch on the inner side of cheek, gums or tongue. It is usually associated with smoking and use of smokeless tobacco. Badly fitting dentures, broken teeth and chewing on one's cheek are other causes of the same. About 5% of leukoplakia cases progress to cancer. Hence the doctor gets a biopsy of the patch done. Leukoplakia often heals when tobacco use is stopped. [4]

Oral Candidiasis (Oral thrush) is a fungal infection caused by a yeast, *Candida albicans*. It can be diagnosed by the creamy, yellow-white or red patches that occur on moist surfaces in the mouth. Tissues under the patch can be painful. Thrush is most common among denture wearers, newborns, those debilitated by disease, and those whose immune system is not functioning properly. People who are undertaking or have just taken an antibiotic treatment or are having a Dry mouth may also experience this diseased condition.

[4,11,12,13,14]

Periodontal disease Periodontal disease is mostly seen in adults. Periodontal disease and tooth decay are the two biggest threats to dental health. These are infections of the gums and may also affect bone that surround and support the teeth. In its early stage, called *gingivitis*, the gums become swollen, appear red, and may bleed. As it becomes more severe, called *periodontitis*, the gums get pulled away from the tooth,

bone can be lost, and the teeth may loosen or even fall out. Bacteria may enter the blood stream and infect other critical areas or organs such as the heart. [15,16,17]

Mucositis: Mucositis is the inflammation of the moist tissue lining the mouth and digestive tract, called the mucous membrane. Mucositis causes painful swelling of the mouth and tongue and can lead to bleeding, pain and mouth ulcers, making it difficult to eat. A patient is more likely to develop mucositis after taking chemotherapy drugs if he drinks alcohol, uses tobacco, does not take care of his teeth and gums, is dehydrated, or has diabetes, HIV or kidney disease. [3,6,16]

Factors affecting oral infections

Certain factors increase the risk for oral or periodontal disease. Each one of these risk factors is important and can be explained as given below:

Smoking: Smoking can lead to many dental health problems such as bad breath, gum disease, oral cancer, etc. It is a powerful risk factor for both cardiovascular and periodontal disease. [11]

Diabetes: Some diseases are associated with an increased risk of infections, e.g. Diabetes. It increases the risks of gingival and periodontal inflammation and infections. This is because if our blood sugar levels are out of control in the body, then sugar is high in our mouth as well. Oral bacteria feed on the sugar to grow and thrive and then attack the protective enamel layer on our teeth, breaking it down to develop cavities – a dental sign of Diabetes. The severity and prevalence of periodontitis are worse in persons with poorly controlled diabetes. Periodontitis may exacerbate diabetes by decreasing glycemic control. This effect indicates a degree of synergism and a link between the two diseases. [3,22]

Poor Oral Hygiene: Research shows that poor oral health causes gum disease which in turn can increase the chances of developing heart disease. Good oral health includes proper care of the tongue, teeth, and gums. However, even with the best of care, the mouth still remains an ideal place for infections to occur as it is warm, moist, filled with bacteria, viruses and food particles to keep infection colonies alive and thriving. Dental health is best maintained when the oral cavity's pH is kept above 5.5 in presence of saliva which neutralises the acidic media created by infections.. Below that level, the process of re-mineralization of the teeth can't keep up with the effect of acids eating away these same minerals. [11,21]

Stress: Excess stress may give you a headache, a stomach ache or just a feeling of being 'on edge'. But too much stress could also have an adverse effect on your mouth, teeth, gums and overall oral health. The

potential after effects of stress and anxiety that can affect your oral health includes [3,5] :

- Mouth sores, including mouth ulcers and cold sores
- Clenching of teeth and teeth grinding (bruxism)
- Poor oral hygiene and unhealthy eating routines
- Periodontal (gum) disease or worsening of existing periodontal disease.

Heredity: Underlying diseases such as diabetes and incidents of recurrent mouth ulcers are usually caused due to heredity or known history of the same in the family. However, the underlying etiology behind this is not known [4.6]

vi Crooked Teeth Or Bridges That Do Not Fit Properly Or Fillings That Have Become Defective : Improperly fitting teeth can cause repeated rubbing and friction in the area around it, causing mouth sores or ulcers. The gaps created in the fittings support entrapment of food particles, thus increasing the risk of bacterial growth and infections. It may even cause oral sores that can get infected by bacteria, virus or fungus. If these defects are noticed, a dentist should be consulted immediately. [6, 21]

vii Underlying Immuno-Deficiencies : Presence of diseases affecting our immune system, such as cancer and HIV/AIDS, may lower the body's resistance to all forms of infections, resulting in severe oral health problems. Thus, there could be an important connection between our oral health and our overall health. [3, 5]

viii Female Hormonal Changes: Women may be more susceptible to dental health issues because of their unique hormonal changes. Hormones not only affect the blood supply to the gum tissue, but also the body's response to the toxins (poisons) that result from plaque build-up. Women are more prone to the development of periodontal disease and other oral health problems during puberty, at certain points in the monthly menstrual cycle, while using oral contraceptives, during pregnancy and at the menopause stage, during which there is a significant change in the hormone levels, [23,24]

Effect of Other Medications.: All drugs come with a risk of side-effects, and hundreds of drugs are known to cause mouth problems. Certain medications we take can be good for treating an ailment, but can also be bad for our oral health. Medicines used to treat cancer, high blood pressure, severe pain, depression, allergies and even the common cold can have a negative impact on your dental health. That is why not only our general practitioner, but also our dentist should know about the medications we are taking, including over-the-counter products, vitamins and supplements.

Some of the most common mouth-related (oral) side effects of medications are listed below.

Dry mouth (xerostomia): Some drugs can reduce the amount of saliva in your mouth, causing an uncomfortably dry mouth (xerostomia). Without enough saliva, the tissues in the mouth can become irritated and inflamed. This increases your risk of infection and gum disease. Saliva washes away food and neutralizes acids produced by bacteria in the mouth, thus, helping us to protect ourselves from microbial invasion or overgrowth in the oral cavity. For e.g. certain chemotherapy medicines, antidepressants, antihistamines, parkinson's disease medications, antipsychotics, alzheimer's disease medications, blood pressure and heart medications, such as angiotensin-converting enzyme (ACE) inhibitors, beta-blockers, heart rhythm medications, calcium channel blockers, diuretics, etc. Drinking lots of water and sugarless chewing gum can help relieve the symptoms. Also, artificial saliva or saliva substitutes help relieve the discomfort to a large extent.[3,25,26]

Fungal infection: Certain inhaler medications used for asthma may lead to a yeast infection in the mouth called oral candidiasis (also called thrush or monilia). Rinsing your mouth out with water after using an inhaler can help prevent this side effect. [3,4]

Gum swelling (gingival overgrowth): Some medications like Phenytoin, Cyclosporin, and calcium channel blockers cause a condition called gingival overgrowth due to build-up of gum tissue. Gum tissue becomes swollen and it begins to grow over the teeth. Gingival overgrowth increases the risk of periodontal disease, as it creates a favorable environment for bacterial growth and subsequently damage the surrounding tooth structures. Men develop this condition more than women. [3]

Mucositis and mouth ulcers : Mucositis and mouth ulcers are common side effects of chemotherapy drugs, aspirin, phenytoin, sulphonamides, gold injections (used to treat rheumatoid arthritis), streptomycin, penicillin, etc.[3,4]

Taste changes: Sometimes a medication we take can alter our sense of taste. A change in the body's ability to sense tastes is called dysgeusia. Some drugs can make food taste different, or they can cause a metallic, salty or bitter taste in your mouth. Taste changes are especially common among elderly patients who take multiple medications. Usually the taste changes are temporary and go away when we stop taking the medicine. Chemotherapy drugs are known to cause of taste changes. [3,4]

Tooth decay: Long-term use of sweetened medications can lead to tooth decay. Sugar is included in many

types of formulation e.g. vitamins, cough drops, antacids and antibacterial syrups. We must rinse our mouth after using such products or use a sugar free alternative, if available.[3,4]

Tooth discoloration: Use of tetracycline antibiotics during pregnancy leads to brownish-colour teeth in children. Too much fluoride (found in some chewable vitamins, toothpastes and mouthwash) can lead to whitish – brown discoloration or permanently stained brown teeth. Ciprofloxacin, Minocycline may cause a greenish or blue-green greyish teeth, while Iron salts can lead to black colored teeth.[3,4,5]

Treatment of the oral infections

Treatment varies according to the type of condition. Treatment for the most common types of mouth sores and disorders is as follows:

Cavities: Tooth decay usually is diagnosed during regular dental visits, and, depending on how badly the tooth has decayed, it may be treated with a filling, crown, or root canal (surgery to remove the pulp of the tooth). A dentist can apply a protective sealant to the molars or use fluoride to help prevent caries. Limiting sweets and frequent snacks; good dental hygiene (brushing and flossing) help prevent caries. Fluoride in various forms can be used for dental caries prophylaxis, where it may promote re-mineralization or reduce acid production by plaque bacteria. Sugar free chewing gum can prevent caries by stimulating saliva production. Dental caries vaccination have also been investigated.[24]

Herpangina usually affects young children and occurs mostly in summer. It is difficult to prevent this. A doctor diagnoses herpangina by examining the appearance and location of the patient's lesions. Treatment includes drinking enough fluid and using over-the-counter medication such as acetaminophen for pain and fever relief. A person also may apply numbing cream to the lesions to ease discomfort.[6]

Canker Sores: Canker sores usually heal after 7 to 10 days, although recurrent outbreaks are common. Non-prescription topical ointments and pain relievers can provide temporary relief. Rinsing with antimicrobial mouth rinses may help reduce the irritation. Antibiotics such as Metronidazole, cotrimoxazole are prescribed to reduce secondary infection.

Experts advise anyone with a canker sore to avoid acidic, hot, or spicy foods and to rinse the mouth and gargle with warm saltwater to relieve pain. There is no known way to prevent the sores. [24]

Herpes or Cold Sores: The blisters usually heal in about a week. Because there is no cure for herpes infections, the blisters may reoccur during times of emotional upset, exposure to sunlight, allergies or

fever. Non-prescription topical anesthetics can provide temporary relief. Prescription antiviral drugs such as Acyclovir may reduce these kinds of viral infections. The most widely used antiviral for herpes simplex infection is acyclovir. Alternatives with improved bioavailability are famciclovir and valaciclovir. Antiviral therapy should be given within first 3 days of the onset of symptoms either topically or orally. In immunocompromised patients with primary symptomatic infection or recurrent episodes of infection, intravenous or oral aciclovir and oral famciclovir and valaciclovir may be used [27,28,29,6]

Leukoplakia: Treatment begins by removing the factors causing the lesions. For some patients that means quitting tobacco use. For others, it means removing ill-fitting dentures and replacing them with properly fitting ones. Doctor monitors the condition, examining the lesion at three to six month intervals, depending on its type, location and size. [3]

Oral Candidiasis: Treatment consists of controlling the conditions that cause the outbreaks. Cleaning dentures is important in preventing denture-induced problems. Dentures should be removed at night. If intake of antibiotics or oral contraceptives is the cause, the dose should be reduced or the treatment changed. In case of dry mouth, uses of saliva substitutes help relieve the condition. Oral candidiasis may be treated with topical clotrimazole, miconazole or nystatin or oral fluconazole. Alternatives are oral Itraconazole and Amphotericin B Topical treatment may not be adequate in severely immunocompromised patients and may require oral azoe treatment. Intravenous Amphotericin B or cospofungin are effective but indicated only in patients with refractory disease. [18,19,20,29, 32,33]

Periodontal Diseases: The treatment of periodontal disease begins with the removal of sub-gingival calculus (tartar) and biofilm deposits. A dental hygienist procedure called scaling and root planing is the common first step in addressing periodontal problems, which seeks to remove calculus by mechanically scraping it from tooth surfaces. Increased floss with salt solution usually reduces the infection.

Penicilin is effective in combating oral pathogens, while erythromycin and Metronidazole are preferred alternatives. Systemic Metronidazole is the drug of choice for necrotising ulcerative gingivitis. Tetracycline and metronidazole have been used for chronic periodontal disease. Antibacterials and antiseptics delivered locally in periodontal cavity could be of added value. Good oral hygiene, physical removal of plaque and use of antiseptics, mainly chlorhexedine, to reduce accumulation of plaque help reduce infections. [29,30,32,33,35,36]

Oral Mucositis: There is no single treatment for mucositis, as it largely depends on which type of mucositis you have and exactly what caused it. For example, things that are effective for oral mucositis caused by radiotherapy may not be helpful if you have gastrointestinal mucositis caused by high-dose chemotherapy. Self-care : If you have oral mucositis, it is very important you have a good oral hygiene routine because it can reduce the severity of your symptoms and how long you experience them. [40]

Use of new delivery systems for oral infections

Researchers have found that over a period of time, many microbes show resistance against the recommended antibiotics of first choice [41]. Due to the serious nature and potential danger that exists from oral infection, there is a need to review the antibiotics available to treat them along with their formulations, doses and possible routes of administration. Thus a successful treatment would require an understanding of the microflora, the regional anatomy, the disease process, the treatment methods available, and interdisciplinary team collaboration [32]

Chemical antibacterial agents used for their prophylactic and therapeutic actions for dental plaque-related diseases are difficult to maintain at a therapeutic concentration in the oral cavity due to resistance development in the target organisms, making them ineffective. Hence, alternative antimicrobial treatment approaches need to be developed. As an alternative to use of antibiotics and antiseptics, the microbes could be made sensitive to light by prior treatment with photosensitizing chemicals e.g. using red light in conjunction with a number of chemical photosensitisers, like Toluidine Blue, phthalocyanines and chlorins. The bacteria can be, thus, eradicated in a short time (seconds or minutes), leaving no scope for resistance development in bacteria or damage to adjacent host tissues. [42]

Topical formulations for oropharyngeal candidiasis are preferred over systemic formulations, but due to limitations of short contact time with the oral mucosa, multiple doses need to be given each day. Miconazole mucoadhesive tablet has been approved in Europe (Loramyc®) and the USA (Oravig™) for the treatment of oropharyngeal candidiasis. This tablet adheres to the oral mucosa and provides sustained local release of miconazole over a period of several hours with just one daily application. This delivery system enables use of lower doses of drugs, especially if the drug is susceptible to First Pass

Metabolism or degradation due to exposure to gastric fluids and enzymes [43].

Other formulations like antiseptic mouth rinse and antiseptic chips containing chlorhexidine; antibiotic gel of doxycycline and antibiotic microspheres of minocycline is also available for treatment. [44]

Conclusion

Oral infections are the second most common infections after common cold. There are many oral infections but the most common are Cavities, cankers sores, Herpes or cold sores, herpangina, oral candidiasis, periodontal diseases, leukoplakia and mucositis. These infections are affected by various factors such as poor oral hygiene, stress, heredity, underlying diseases like diabetes, Immuno- deficiencies as caused by cancer, HIV infection, improper fitting of teeth, Femal hormonal changes, concurrent medications being taken, etc. Regular Oral hygiene helps reduce the infections which can further be treated with antibiotics and antiseptic agents. The Oral Health of a person speaks volumes about the overall health of the person. These are further scope for using novel drug delivery systems or novel therapies for these infections.

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