ROUTES OF TRANSMISSION OF DISEASES IN DENTAL PRACTICE

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Contamination and infection

Transmission of microorganisms eg. bacteria, viruses, fungi and protozoa is a hazard in dental practice (1-4). Introduction of microorganisms on instruments *(contamination)* is unavoidable during treatment of a patient since:

1. The oral cavity harbours millions of microorganisms
2. Blood of the patient may contain microorganisms

If blood contains microorganisms they usually belong to the group of *pathogens*, microorganisms that cause diseases. However the patient may also harbour pathogens in the oral cavity due to certain diseases. It is of paramount importance to apply procedures that will completely eliminate all microbial life on the used instruments *(sterilization)*. In case instruments cannot stand such procedures the minimal requirement is to destruct all microorganisms except the spores *(disinfection)*. As long as extensive surgery is not performed, spores do not pose a threat during dental treatment. The aim of eliminating microorganisms on used instruments is to avoid contamination of the next patient. Introduction of microorganisms to the body (contamination) does not necessarily lead to establishment and accumulation of microorganisms in the body *(infection)* and consequently disruption of the normal performance of the functions of the body *(disease)*. Whether this occurs or not depends on:

1. The ability of a microorganism to resist the body's defence mechanism. *(virulence of the microorganism)*
2. The number of microorganisms introduced to the body *(dose of contamination)*
3. The *port of entry* which determines the ease with which pathogens may establish and accumulate in the body. Port of entries with respectively low, moderate and high chances of infection are intact skin, lesion and needle stick.
4. The general condition of the body's *defence mechanism*
5. The presence of the *immunological system* of the body which has been triggered by previous contact with the same microorganism.

The above points explain why the occurrence of infection after contamination is unpredictable. However by avoiding contamination by using *aseptic* (in the absence of microorganisms) procedures, *cross-infection* (from one person to another) can be completely prevented.

Modes of transmission

Some *cross-infections* in dental practice have been well documented eg. hepatitis B, tuberculosis and herpes simplex. Many other diseases can be transmitted although reports about the extent are yet lacking.

The routes of transmission of microorganisms in dental practice are depicted in Fig 1 and 2. The routes of transmission that can lead to infection may differ depending on the microorganisms that are transmitted. Direct blood contact via a lesion on the hands or introduced by a needle is an effective route for hepatitis viruses B, C, and D, whereas contamination with droplets from the patient's mouth to the respiratory tract of the operator can easily cause tuberculosis and other respiratory diseases.

Transmission from patient to operator

The routes of transmission from patient to operator are:

a. From the mouth of the patient through lesions on the operator's hands, either existing lesions or lesions caused by prick accidents (Fig 1,

route 1). Lesions on the operator's hands and prick accidents pose a real threat to the dental operator's health. It has been estimated that approximately 1 out of 6 prick accidents with blood contaminated instruments that contained HBV caused infection. The prevalence of HBV contact among dental operators is much higher than among the general population, indicating that dental operators are at risk of contracting hepatitis. In case of HIV containing blood, the chance of acquiring infection after one prick accident is less than 4 out of 1000.

b. Via contaminated hands of the operator who subsequently touches his mouth, nose and eyes (Fig 1, route 2). Herpes simplex infection around the lips and conjunctivitis are well known infections contracted by dental operators due to inappropriate hygiene.

c. Via splashed material from patient's mouth in operator's face (Fig 1, route 3) Particularly the eyes are susceptible for infections through this route of transmission. But also respiratory diseases can be transmitted through this route. Infection with HBV and HIV through this route is less likely, but in case of microlesions in the face caused by sharp particles in the splash, the risk of contracting cannot be excluded.

d. Via inhalation of aerosols (Fig 1, route 4). High-speed rotary instruments and ultrasonic scalers with air-water spray create fine droplets which remain suspended in the air. These aerosols are highly contaminated with microorganisms from the patient's mouth and blood. The aerosols usually contain numbers of microorganisms comparable with numbers present in a sneeze. Viruses and bacteria that can cause respiratory diseases have been isolated in dental aerosols. It has been reported that dental operators experience a higher incidence of respiratory diseases than their medical collegues. Since dental operators are usually in very close contact with the patient, they can easily contract respiratory diseases if adequate precautions are not taken.

e. Via inhalation of dust (Fig 1, route 5). Dust from outside is not posing a real treat to patients and dental personnel in the dental surgery but the dust contaminated in the dental surgery by blood spillage and by dental aerosols may act as a mode of disease transmission. Microorganisms in droplets and in aerosols after drying on nearby surfaces may be swirled into the air on dust. Therefore sweeping the floor of the dental surgery is inappropriate since it redistributes microorganisms instead of removing them. Daily mopping is the only adequate procedure. Surfaces on cabinets, chair etc. can be cleaned with a paper towel impregnated with 70% alcohol or with 0.5% chlorhexidine in 70% alcohol.

Fig. 1 Routes of transmission from patient to operator

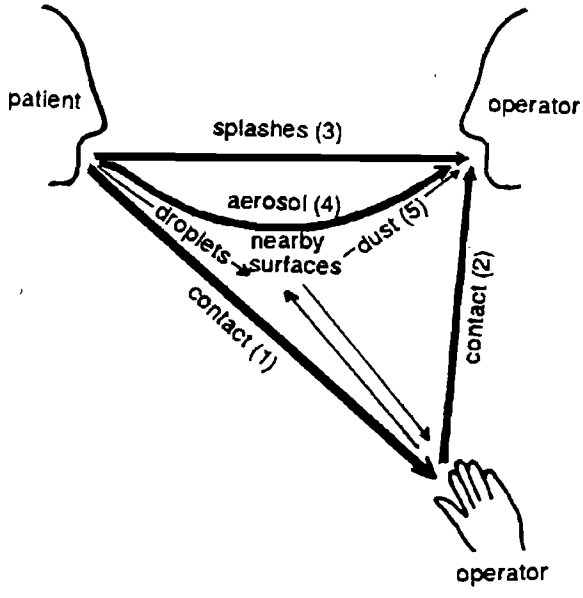
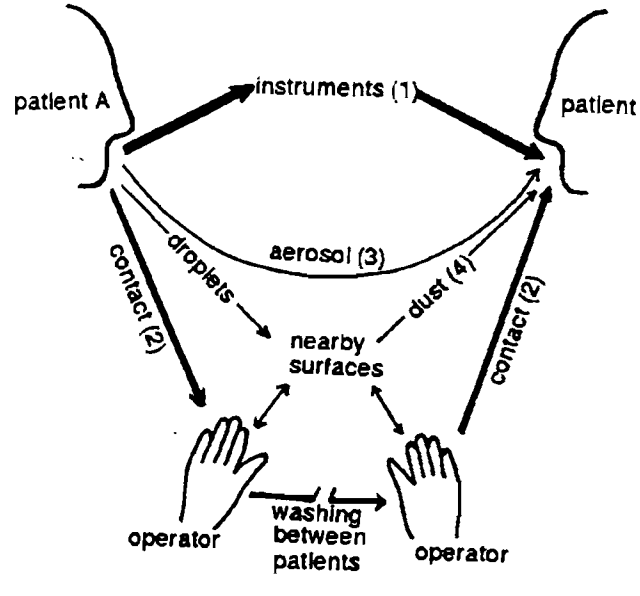


Fig. 2 Routes of transmission from operator to patient and from patient to patient



Transmission from operator to patient

The route of transmission from operator to patient occurs via existing lesions on operator's hands who carries an infectious disease (Fig 2, route 2). There is documented evidence that dental operators with hepatitis B have infected patients through lesion on their hands. It has also been reported that local herpetic infections on the operator's hands, known as *herpetic withlow* has been transmitted to patients who consequently developed herpetic gingivostomatitis. These infections would not have occurred in case the dental operators had used gloves.

Transmission from patient to patient

The routes of transmission from patient to patient are:

a. Via instruments which are not sterilized or which are recontaminated due to inadequate storage (Fig 2 route 1). This route is the most hazardous one between patients. Since it is known that drug abusers spread HBV and HIV through the collective use of non sterilized needles. Likewise patients can be infected with HBV and HIV during dental treatment with non sterilized instruments.
b. Via operator's hands in case no change of gloves or no washing between patients are performed or when hands are recontaminated by touching contaminated surfaces, switches, knobs etc (Fig 2, route 2)
c. Via aerosol and dust (Fig 2, route 3 and 4)

Relative risk of transmitting diseases

The dental operator who is in 'intimate contact' with the patient during treatment (hands in contact with oral mucosa, saliva and blood, face to face distance less than 30 cm during cavity preparation) can easily be infected through the different modes of transmission (Fig 1).

Table 1 shows the relative risks of infection by different diseases through different routes of transmission for the operator in case the patient carries the disease and hygienic precautions are not applied. Infection occurs depending on the five factors mentioned previously, eg 1. virulence of the microorganisms, 2. dose of

Table 1. Infectious hazards for dental personnel in the surgery

Routes	Disease	Risk High	Moderate	Low
1. Via lesions on hands	Hepatitis B*CD	x		
	HIV			x
	Other ST diseases+		x	
	Child diseases°			x
	Meningitis*		x	
2. Via hand to face	Hepititis B*CD			x
	HIV			x
	Other ST diseases+			x
	Conjunctivitis		x	
	Candidiasis			x
	Rhinitis			x
	Child diseases°			x
3. Via splashed material	Child diseases°			x
	Diphtheria*			x
	Flu, common cold	x		
	Tuberculosis*	x		
	Candidiasis		x	
	Pneumonia		x	
	Conjunctivitis		x	
	Meningitis*	x		
	Rheumatic fever		x	
	All ST diseases+			x
4. Via inhalation of aerosol	as under 3		but risk is lower	
5. Via inhalation of dust	as under 4		but risk is lower	

* Active immunization is possible - for meningitis only the one caused by neisseria
\+ Sexually transmitted - herpes simplex, syphilis, gonorrhoea, infectious mononucleosis
° Child diseases - whooping cough* rubeola*, rubella*, mumps*, poliomyelitis*

Table 2. Infectious hazards for patients in the surgery

Routes	Disease	Risk		
		High	Moderate	Low
1. Via instruments and hands	Hepatitis B C D	x		
	HIV		x	
	Other ST diseases		x	
	Child diseases		x°	
	Meningitis		x	
2. Via aerosol and dust	Child diseases		x°	
	Diphtheria			x
	Flu, common cold		x	
	Tuberculosis		x	
	Candidiasis			x
	Pneumonia			x
	Meningitis		x	
	Rheumatic fever			x

° Risk for children in case they are not vaccinated or yet not exposed

contamination, 3.port of entry, 4. defence mechanism and 5. immunological system of the body. Thus for instance the frequent contamination of highly infective microorganisms that cause child diseases may pose only a small risk of infecting the operator since in general the operator has developed a specific defence mechanism since childhood. The risk of contracting some diseases by the operator can be minimized by vaccination, eg. hepatitis B, neisseria meningitis, diphtheria, tuberculosis, and poliomyelitis. However other diseases pose a threat of infection unless the dental operator applies adequate hygienic precautions to avoid contamination.

Table 2 shows the relative risks of infection from patient to patient through instruments and operator's hands and via aerosol and dust. The overall risk of cross-infection in dental practice is besides the five factors mentioned previously and the level of hygiene practised also dependant on the prevalence of diseases among the patients. Thus although Table 1 for instance shows a comparable risk of infection for common cold and meningitis via splashed material, the overall risk of contracting common cold is much higher than that of meningitis due to the higher frequency (prevalence) of common cold diseases among patients.

References

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