To discover a possible route for cross-infection from podiatric drill handpieces

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SUMMARY. The aim of this research project was to establish the presence of bacteria and/or fungal spores in podiatric drill handpieces. Then, to ascertain if any organisms present could be considered a cross-infection risk to patients and others, and establish a means of controlling that risk. This was assessed by collecting samples of dust from the two different types of handpieces used at the Leaf Hospital, Eastbourne and examining them by means of microscopy and culture. Ten handpieces in all were examined, five Suda 650 model types and five Berchtold S30s. From the results obtained it showed that the handpieces did contain bacteria and fungal spores which were a combination of pathogenic and non-pathogenic microbes. All the microbes found are not generally regarded as a problem for the normal healthy individual. However, with predisposing host factors, some of them are known to cause infections which can threaten both life and limb of the patient.

INTRODUCTION

Podiatrists and their patients are not considered to be at high risk for infections from podiatric procedures. However, with the increase of blood-borne diseases such as Hepatitis B and the outbreak of the AIDS epidemic, concern about infection control has arisen.1 The discovery in 1988 that a New York dentist had contracted the AIDS virus in the process of treating an infected patient shook the medical profession.2 This was fuelled further by the discovery that a Florida dentist by the name of David Acer who had died of AIDS, was followed to the grave by six of his patients who had contracted the disease. There was evidence to suggest that Acer had deliberately infected his patients, although it was unsure as to how this had been done. The theory was that it was through his dental drill that he had used to clean his own teeth.3

As dentistry exposes a large percentage of the population to blood-to-blood contact with infected patients, a careful evaluation of all dental equipment that could transmit infections was necessary.4 This led to an investigation into some types of re-used dental equipment, especially handpieces and their attachments for drilling and cleaning teeth.5 This type of equipment contains many crevices which can collect infective patient materials and are extremely difficult to clean and disinfect adequately.6 Studies on high-speed dental handpieces showed that they could take up and expel patient materials, thereby potentially transferring infectious organisms from one patient to another. Live bacterial contamination was found present in variable amounts on both external and internal surfaces of all handpieces.7 Waterlines leading into handpieces to cool down some of the dental procedures also came under scrutiny. Tests showed that these waterlines provided an ideal environment for organism formation, and that these were unlikely to be flushed out readily. Instead, they became entrapped and periodically shed pathogens during dental procedures.8

The cross-infection problems associated with dental handpieces then fell clearly into two distinct categories. The first being the pathogenic bacterial and fungal growth found in waterlines. Second, the contamination of crevices and airways with patient materials harbouring many kinds of pathogens, including viruses.9

It was the results of the investigations carried out on the dental handpieces that was the inspiration for this research project. If it was possible for dental handpieces to become contaminated from infective patient materials, was there a chance that the same could apply to the ones used in podiatry? If so, what would be the implications for cross-infection, especially with the advent of water-spray handpieces currently coming into the podiatric field?
NAIL DUST

The use of nail drills by podiatrists in the management of thickened toe nails and sanding discs for the treatment of callouses is now common practice. These procedures cause the production of nail dust particles and hyperkeratotic debris, which have been found to contain elements of fungi and other infectious microorganisms. Owing to the potential hazard of nail dust aerosols, most drills today are fitted with dust extractors. There are two basic types of extractors; the vacuum system and a water-spray system.

CROSS INFECTION

The pathogenicity of a micro-organism depends not just on the structure, invasiveness and ability to produce toxins, but also on host susceptibility. Only virulent pathogens can cause infection in a completely healthy host, however, opportunistic pathogens (i.e. Staphylococcus aureus and Candida albicans) can cause infection when the circumstances favour them. Pathogens very rarely manage to penetrate intact healthy skin, as it forms a barrier against most pathogenic bacteria. They usually enter the skin via small abrasions, ulcers and areas weakened by excess moisture. However, they can also gain entry during or after surgery, or from nail-reduction procedures or treatment of keratoses or verrucae.

Infections caused by organisms from an endogenous source may gain access to any vulnerable areas on the foot. Exogenous sources are from infected or colonized people, animals or environmental sources. The survival of micro-organisms outside the body is dependent upon their requirements and the conditions in the environment. Organisms need moisture in order to grow, and any wet areas in the clinic are potential sources for them to survive in. They can also survive in dry sites such as in areas of dust and dirt, although Gram-positive bacteria and fungi fare better than Gram-negative bacteria.

In order for an infection to occur, the micro-organisms from either the endogenous or exogenous source need to be transmitted either to a new host or host site. This can be by direct contact (i.e. via hands) or indirect contact (i.e. via inanimate objects), burrs and handpieces fall into the latter category.

NORMAL FLORA

The normal resident flora of the skin predominantly consists of Staphylococcus epidermidis, micrococi and diphtheroids. The transient flora consists of a larger group of organisms which can invade and contaminate a person's skin from another body site, the environment or another person (e.g. Staphy. aureus). In a healthy person the normal flora represents no threat, but it can when the skin becomes damaged, when local conditions allow excessive growth or the individual is weakened by a systemic disease, such as diabetes. While most infections encountered on the feet may not be particularly serious, they can cause great discomfort and even immobilization.

The microbiology of normal nail flora is similar to that of the skin. Trapped dust particles may carry fungi and bacilli, for example, Aspergillus, Penicillium, Cladosporium and Mucor.

FUNGI AND YEASTS

Filamentous and yeast-like fungi are frequently isolated from the skin, especially the foot, so it is hard to determine whether they are resident or transient organisms. The dermatophytes are filamentous fungi which cause ringworm in humans and animals, and are one of the most common causes of infections of the foot, known as tinea pedis. Although the dermatophytes are the commonest cause of fungal infections, there are other assorted saprophytic yeasts or mould-like fungi, which also cause infections and are termed the non-dermatophytes.

METHODS

The ten handpieces tested were randomly selected. Five handpieces from each of the two drill types in use were selected so that a comparison could be made regarding their microbial content. The samples were collected early in the morning before any personnel were present in the clinic, to minimize any disturbance to the tests being carried out. All windows and doors were kept closed to prevent draughts. This time of day was chosen in order to observe what bacteria, if any, could survive in the handpiece for more than 16 hours after the last clinical session.

Petri plates used for culture:
1. Nutrient agar for bacterial organisms such as the staphylococcus species.
2. Sabaurauds agar for culture of the filamentous fungi such as the dermatophytes.
3. Czapek Dox agar for yeasts.

Before sample collection each plate was labelled with the number and type of the handpiece and the area the sample was being taken from. Six sterile swabs, one sterile napkin, one pair of surgical gloves, one sachet of saline solution and six pre-labelled petri plates (two of each type) were placed in the clinic cubicle. The sterile napkin was placed on a disinfected work surface. Wearing sterile gloves, the handpiece was carefully opened over the napkin, taking great care not to disturb the dust adhered to the inside of
the handpiece. Dust was sampled from two sites inside the handpiece; the tip and midway down the shank, using a saline soaked swab.

Each dust sample was plated out on the three different agar plates. The nutrient agar plates were incubated at 37°C and the Czapek Dox and Sabaurauds agar plates were incubated at 25°C. The procedure was repeated with the remaining nine handpieces.

The nutrient agar plates were checked at 24 and 48 hours for any bacterial growth. There was evidence of growth on a number of plates after only 24 hours. On day 4, all the plates which had evident growth were taken to the Microbiology Laboratory at the Eastbourne District General Hospital (EDGH) for identification.

The Czapek Dox and Sabaurauds plates were checked at 7 and 14 days. Any plates after this period of time which showed no signs of growth were discarded. The remainder were taken to the Microbiology Lab at the EDGH, where they were kept for a further 7 days before any identification of fungi or yeasts was made.

RESULTS

The culture results clearly indicate that the inside of the drill handpieces do indeed harbour a variety of micro-organisms. However, in order to assess any potential risk factor, each of the organisms needs to be considered (Figs 1–3).
Staphylococcus species

There are at least 19 species of Staphylococcus currently recognized, although only three are commonly associated with human disease: *Staph. aureus*; *Staph. epidermidis*; and *Staph. saprophyticus*. Essentially, all of the serious diseases involving the Staphylococci are caused by *Staph. aureus*.

*Staph. aureus*

Most strains are potentially pathogenic and it is a common cause of infection in the community and in hospitals. The great majority of these infections tend to be superficial inflammatory lesions with pus formation, such as abscesses, paronychia, impetigo and wound infections. Deep infections may occur, particularly following trauma or surgery and include osteomyelitis, sepsicaemia and septic arthritis.

*Staph. epidermidis*

This is usually regarded as being non-pathogenic and in general is not a problem for the normal healthy individual. However, it has now become an opportunistic pathogen causing infections in association with foreign bodies/implants. A study conducted by Stabile and Jacobs (1990) on the typical organisms found in soft tissue and bone infections of the foot, discovered that the two most common types isolated were *Staph. aureus* and *Staph. epidermidis*.

Micrococcus

This genus only comprises non-pathogenic species and form one of the major components of the human skin flora.

Bacillus

Members of this genus are often encountered in wounds, particularly after road accidents, in discharges from chronic ulcers and from other sites likely to be contaminated with soil and dust. Some Bacillus species can cause infections, but only in severely immunocompromised patients or when introduced traumatically into normally sterile tissues, although reports of various species causing clinical infections are increasing.

Aspergillus species

These are non-dermatophyte filamentous fungi which are commonly found in soil and dust everywhere, and their spores are frequently isolated from the air and are constantly being inhaled. They colonize on dead organic matter, in wounds, and in compromised hosts such as diabetics, the malnourished, immunosuppressed and AIDS patients. Although there are more than 300 Aspergillus species known, only a few of them are ordinarily pathogenic in man. They are also known to be the cause of onychomycosis, with *Aspergillus nigra* resembling a dermatophyte infection. A study conducted by Abramson and Wilton (1992) revealed that finding *A. fumigatus* as a cause of onychomycosis raised another interesting question. What hazard would this present to the podiatrist or predisposed persons owing to its association with deep mycosal broncho-pulmonary infections, and the fact that nail dust has been shown to remain intact and potentially infectious.

Penicillium species

These are filamentous fungi frequently isolated from the soil and air. When isolated from the normal skin they tend to be considered as a contaminant and are rarely pathogenic in man.

Scopulariopsis brevicaulis

This is a non-dermatophyte saprophytic mould which causes mycotic infections of the nails. This organism does not respond well to available antifungal therapy.

Environmental contaminants/fungi

These are organisms which are found in the hospital environment. They tend to consist mainly of Gram-positive coagulase-negative staphylococci, a few diphtheroid species and aerobic spore-forming bacilli. These are normally considered to be unlikely to cause infection except during implant surgery, or if they come into contact with any susceptible sites on certain individuals.

DISCUSSION

Every handpiece tested was shown to contain some type of micro-organism, although the numbers and quantities varied. Two sites were used for sampling, the tip and midway down the shaft. The results did not indicate that one site contained a significantly higher proportion of micro-organisms than the other, thereby suggesting that the whole of the inside of the handpieces are fairly evenly contaminated.

There was no marked difference in the number of micro-organisms found between the two different types of handpieces examined. However, the presence of pathogenic and opportunistic micro-organisms within the handpieces does indicate that there is a potential source for cross-infection.

The proliferation of some of the microbes found in the handpieces as primary skin pathogens or secondary opportunistics could result in symptomatic and severe cases of foot infections. In high risk patients, for example diabetics, any foot infection can...
threaten both life and limb. As the majority of patients treated by podiatrists, especially in hospitals, are in the high risk category, ways of preventing any potential risk of cross-infection from handpieces should be examined.

The current practice of using sterile procedures in chiropody has gradually evolved over the years, as the scope of practice has increased from simple conservative footcare to extensive podiatric surgical methods. Two methods are employed to achieve this, disinfection and sterilization.

So, what would be the recommended method of destroying the organisms found within the podiatric handpieces? A study was conducted by Lewis et al (1992) into the cross-contamination potential of dental equipment. They concluded that dental handpieces should be cleaned and heat-treated between each patient to kill any microbes in the internal areas. This was not only to prevent contamination hazards from material passed directly to the patient, but also to prevent contamination to the surrounding environment.

In 1987 the Society of Chiropodists issued guidelines on sterile procedures for use by podiatrists in order to control cross-infection in routine chiropody practice. They recommend that all instruments should be cleaned thoroughly and then sterilized, especially ones likely to be contaminated with blood, and merely suggest that autoclavable handpieces be considered. The method of choice for sterilization is an autoclave which can reach a temperature of 134°C for a minimum of 3 minutes.

The Society only recommends the use of autoclavable handpieces after chiropody treatment for patients carrying blood borne viruses including Hepatitis B and HIV. Unfortunately the majority of carriers of these type of diseases are not identified and are receiving routine treatment. Cross-infection from bodily fluids, however, does not rely on a major lesion caused by a scapel, they only need a miniscule portal of entry which may not be large enough to see with the naked eye. Therefore, surely this should reinforce the need to use autoclavable handpieces.

Autoclavable handpieces have been manufactured since the early 1980s, with a selection of them on the chiropody market. There are also various autoclaves now available on the market including portable models, thereby increasing the scope of practice for those chiropodists with domiciliary rounds.

Recommendations for cleaning handpieces:

1. Handpieces should be emptied and cleaned away from any clinical area, and on a regular basis, such as at the end of every day.
2. Any person cleaning or repairing them should wear rubber gloves, especially if they have any skin abrasions on their hands or fingers, to prevent cross-infection, and masks to prevent inhalation of organisms.
3. The contents of the handpieces should be disposed of following Health and Safety guidelines.

CONCLUSION

The fact that quite a few environmental contaminants and fungi grew on the culture plates could be due to three possible explanations. The first is that the plates were contaminated from the atmosphere when opened briefly to smear the dust on them from the handpieces.

Secondly, some of the plates could have been contaminated before they arrived, although again this is probably unlikely. However, the third and most likely explanation was that they were either drawn in from the atmosphere when the drill was in operation, or that the skin and nails of individuals are all contaminated with numerous environmental contaminants.

Dust samples were taken at least 16 hours after the end of the last clinic. Certain bacteria and fungi are known to be able to survive outside the body depending upon their requirements. Organisms can survive for long periods either in wet areas or areas of dirt and dust, especially Gram-positive bacteria and fungi.

The advent of water-spray handpieces onto the chiropody market could pose even more problems for potential cross-infection from water lines, such as those discovered from dental handpieces in a study conducted by Lewis & Boe (1992). Therefore, further studies into this area of cross-contamination, as well as the previous suggestions would be of immense significance to future recommendations for infection control and sterilization within chiropody.

REFERENCES


