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This essay will demonstrate the health and safety aspects related to dental biomaterials, which are used by dental technicians to construct appliances, and the factors used to select biomaterials by dental technicians in relation to appliance performance. There are different ways and procedures which contribute to health and safety. Standard Operating Procedures (SOP) are important part of the process in dental laboratory. They are documented instructions produced by the organisation itself. They maintain and maximise safety within the workplace, they maintain quality standards and help organisations to comply with regulations (Lina, 2016).

Auditing and keeping records is a way to provide evidence to regulatory bodies. A great way to train staff and create risk assessments on biomaterials is to keep Material Data Sheets. Material data sheets provide information about chemical products. They help chemical users make risk assessments. They describe hazards the chemicals cause (HSE, 2017).

By law for suppliers of a chemical must produce updated versions of a data sheet if the chemicals are dangerous or harmful. Such as, methyl-methacrylate. Methyl-methacrylate undergoes rapid, uncontrolled polymerization, and produces rapid release of energy in heat form.

Data sheets also give information on company details, product and hazard identification, constituents, handling, storage and emergency measures in case of an accident. For example for handling –keep away from heat and from sources of ignition etc. Information on the data sheet about storage will include; flammable materials must be stored in safety cabinets/room, keep away from heat etc. The data sheets will mention information on traceability.

Traceability is very important as everything must be recorded to trace back in the case of litigation. If a regulatory body wants to audit the company or inspect them, then have all recordings needed. To ensure a safe working environment they must be checked every year so staff carry out correct protocols.

Risk assessment is a process which will reduce; accidents, injuries, faults and near misses. Risk assessments support practice policies and protocols, improve the quality of the services and keep people safe (Cash, 2015). The five steps for risk assessing are; to identify hazards, to decide who/how one may be harmed, to evaluate the risks and decide on precautions, record findings and make sure to put them into practice, and regularly update them when needed (Johnson et al.

, 2016). When using biomaterials, risk assessments are very important to avoid hazards. Control of Substances Hazardous to Health Regulations 2002 (COSHH) works in accordance to risk assessments. COSHH is a piece of legislation that applies to infections at work. COSHH applies to substances that can cause harm to anyone's health.

These substances can be in different forms, for example chemicals, products which contain chemicals, gases, vapour and fumes that can cause diseases (COSHH, 2002). Use of personal protective equipment (PPE) is very important. Compliance concerning PPE is usually dependent on personal choice. However, added comfort, allergies, ergonomics and body temperature regulation generally translates into increased levels of compliance.

The design of PPE is to safe guard both staff and patients by constraining direct contact and contamination. PPE should be removed carefully. After removal of PPE, immediately perform proper hand hygiene. There is an order for wearing PPE. Gowns/lab coats first, then masks or respirators then eyewear and/or face shields follow this and finally, gloves.

The different PPE used will affect the sequence of placement. Careful use of PPE is always desirable. PPE should be removed in the following order; gloves, protective eyewear and/or face shields then gowns and finally, masks/respirators. Hand hygiene facilities should be available at the point of need.

This includes a sink with appropriate hand hygiene products or alcohol-based hand rubs. The use of PPE is an important part of standard precautions. Standard precautions assume body fluids and blood of any patient could be infectious. The sort of clinical association that will occur decides final decisions about the utilisation of PPE. Standard precautions have certain recommendations concerning various forms of PPE, such as; gloves are worn when touching body fluids, secretions, and contaminated items. There are five basic types of PPE used in healthcare setting: gloves to protect hands, gowns/laboratory coats to protect skin and/or clothing, masks/respirators to protect the mouth/nose (respirators also protect from airborne infectious agents), goggles and face shields to protect face, mouth, nose, and eyes. Gloves don't prevent sharps injuries, but wiping effect of gloves reduce risks of contamination of the wound.

They are recommended for all dental treatments but shouldn't be worn as an alternative to hand-washing. They are single use and are for the start of the treatment and removed at the end of the procedure. To avoid contamination, remove gloves aseptically so the outside of the glove is not touched with the bare hand.

Gloves can tear during use and may leak, so hands should be cleaned after disposing them. They made of nitrile or neoprene and are preferred over latex gloves as staff and patients can become sensitised to latex used in glove manufacture. Goggles face masks or respirators should be worn during all types of dental treatment, such as making appliances or when manually cleaning instruments. Different types of Respiratory Equipment are available. The important part of respirators are the filter. Filters are available for solid or liquid particles, vapours and gases (HSE, 2013). It is important that the incorrect filter isn't chosen.

The micro dust particles released when trimming of different materials in the laboratory will cause extreme long term breathing and lung problems such as Chronic Obstructive Pulmonary Disease or Chronic Bronchitis (British Lung Foundation, 2017). Eyewear protects from splatter such as amalgam fragments. Visors can be worn over spectacles. Visors also have the advantage of preventing touching the face with contaminated gloves. PPE is important when handling dental materials. Handling materials in the laboratory is important and there are regulations regarding this.

Such as, the Manual Handling Operations Regulations 1992 (MHOR). MHOR help employers and employees to reduce and control risks of injuries from

manual handling. MHOR require employers to avoid hazardous manual handling and assess risks of injury from hazardous manual handling which can be avoided (HSE, 1992).

Employers must give correct training to all employees regarding the materials they will work with and come into contact with. This shows how important the handling of materials in the dental laboratory is. Moreover, the disposal of dental waste materials is vital as they are a risk to the environmental and public health (Environmental management, 2017).

Clinical waste management is waste being segregated. Amalgam/gypsum waste are put into white containers. Sharps/Infectious waste are put into yellow bags. Legally the producer is required to segregate and label wastes then ensure it is stored and collected correctly (Department Of Health, 2016).

An example of a material that must be disposed of safely is methyl-methacrylate.

This material can be disposed of in two ways; by breaking up into small particles in a suitable combustion chamber or absorbing it in dry sand or a similar material and disposing it in a landfill site where the odour won't be objectionable. If it is spilled/leaked then all ignition sources should be removed and area must be well ventilated, small quantities must be absorbed by paper towels and should be evaporated in a safe place such as a fume hood. Methyl-methacrylate should also be stored in a dry cool place.

(Occupational health guideline, 1978). There are five types of dental plaster which each have a different purpose. Type I dental stone which is commonly known as impression plaster. Type I is rarely used for dental impressions. It

has been replaced by less rigid materials like hydrocolloid or elastomers such as alginate. This plaster is primarily restricted to use as a final impression in constructing of full dentures. It is composed of plaster of Paris and is calcined which is derived from gypsum.

It is also flavoured and coloured better for patients use. There are modifiers added to regulate the expansion and setting time. Type II is used to produce study and primary casts. This plaster is used to fill up flasks when constructing complete dentures. It is a natural white colour and sets fast however should have enough time to manipulate.

This plaster shouldn't lose strength when subjected to moulding. This plaster is a beta form of calcium sulphate-hemihydrate. Type III is an alpha form of calcium sulphate-hemihydrate and is used to make master casts. It is marketed as coloured powder or cement.

When this is mixed with water, it sets as a hard mass because of its prismatic dense structure. Type IV plaster has high strength and is an alpha hemihydrate with cuboidal shaped crystals. Its abrasion resistance and has minimal setting expansion.

Type V dental stone exhibits higher compressive strength than type IV. Correct manipulation and mixing techniques should always be used when casting. Incorrect ratios will cause different expansion rates resulting in badly fitted devices (McCabe and Walls, 2008). The three basic dental materials are; dental ceramics, dental polymers and dental metals. Dental ceramics include glasses, inorganic salts and crystalline ceramics. Dental polymers

include of waxes elastomers and rigid polymers. Dental metals are materials such as alloys and intermetallic compounds. A common dental ceramic is porcelain.

It is used to make veneers, fixed partial dentures and crowns. Porcelain is white translucent ceramic that is fired to become glazed. Porcelain is grouped with its fusion temperatures, such as, high fusing which ranges between 1288°C to 1371°C. The disadvantages of fusing porcelain are, it is brittle and resists bonding to acrylic denture bases.

However it increases the marginal accuracy, is natural looking, establishes predictable natural polychromatic colour within the porcelain with good contours and surface textures, and shortens final placement time (T. Taniguchi, 1990). Zirconia is another common ceramic used in the laboratory. It is used for implants, crowns, and bridges because it has high fracture toughness and very good biocompatibility. It is translucent ceramic and has a natural colour.

Polymers have a major role in dentistry. A polymer is a chain which is built up by repeating atoms derived from small molecules or monomers.

Monomers are liquids or gases, which are converted to amorphous/structureless solids during a polymerisation process. This varies from being very rigid to being soft or rubbery (McCabe and Walls, 2008). Polymers are used in impression materials such as elastomeric polymers.

They are also used in composite filling material for anterior teeth. Removable dentures are made from acrylic-resin and other polymers. Other appliances that use polymers include soft-liners, cements and fissures-sealant. An ideal polymer material should replicate the soft tissue and different colours found in teeth. The properties polymer make it possible to construct a denture base. The teeth should have a glass transition temperature high enough to stop softening and distorting when being used. The polymer's dimensional stability should be very good, as the shape of the denture may otherwise change over time. The polymer must have a low value of specific gravity, to decrease the weight of the denture, this reduces the gravitational displacing forces on an upper denture.

The denture has to be radiopaque to allow early radiological detection of the denture (Sahin, 1998). Selecting alloys is determined by a number of factors, such as the cost because some precious metal prices fluctuate. Alloys are mixtures of two or more metals. Metals have a structured form. Finer-grain structured metals are harder than coarser structured ones and have higher values and yield stress. (McCabe and Walls, 2008) Mechanical properties of an alloy include ductility, strength and stiffness. Stiffness occurs due to the elastic modulus.

The higher the elastic modulus, the stiffer the structure. This is important when doing long cast parts, span bridges, partial dentures and denture clasps. Alloys are required to have high yield stress so the clasps balance. The melting range affects the way the alloy fits because, casting will cause the cooling contraction and shrinkage, and the appliance to be small. So the

higher the shrinkage the more problems. Alloy density is vital because greater density means easier to force into a heated mould. This forces air/gases out to give a more accurate casting. Legal and ethical factors are important when using and selecting suitable materials.

Dental teams are administered by the General Dental Council (GDC). GDC set out standards for the dental team to work safely, for example one GDC standard states all staff members should protect and maintain patients' information. This means patient information such as details mentioned on the lab ticket must be kept safe and out of access from the public (GDC, 2017). MHRA is another regulatory, who check the quality and safety of medical devices and check medical devices don't go against the country's law system. They work alongside MDD who ensure all manufacturers place a CE mark on all devices.

(MHRA, 2017) In conclusion, technicians select correct material types by understanding and knowing the materials used, and all staff should always follow the health and safety protocols to avoid accidents, as biomaterials can be very harmful if they aren't handled, stored or disposed of correctly.