Medical Devices

Somya Kabra

January 2022

NIT RAIPUR

List of Medical devices :-

0.1 Artificial Heart Valve

0.2 Dental Microscope

0.3 Mobile CT

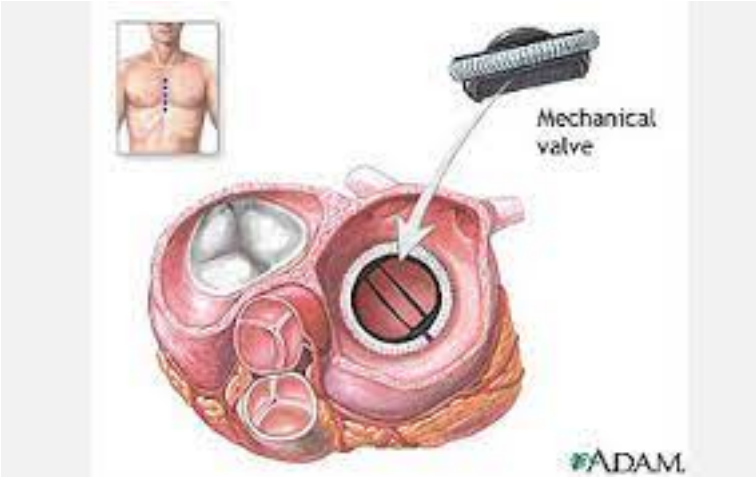
0.4 Retinal Camera

0.5 Stress Test System

---

1 Artificial Heart Valve

An artificial heart valve is a one-way valve implanted into a person's heart to replace a heart valve that is not functioning properly (valvular heart disease). Artificial heart valves can be separated into three broad classes: mechanical heart valves, bioprosthetic tissue valves and engineered tissue valves.



The human heart contains four valves: tricuspid valve, pulmonary valve, mitral valve and aortic valve. Their main purpose is to keep blood flowing in the proper direction through the heart, and from the heart into the major blood vessels connected to it (the pulmonary artery and the aorta). Heart valves can malfunction for a variety of reasons, which can impede the flow of blood through the valve (stenosis) and/or let blood flow backwards through the valve (regurgitation). Both processes put strain on the heart and may lead to serious problems, including heart failure. While some dysfunctional valves can be treated with drugs or repaired, others need to be replaced with an artificial valve.

A heart contains four valves (tricuspid, pulmonary, mitral and aortic valves) which open and close as blood passes through the heart.Blood enters the heart in the right atrium and passes through the tricuspid valve to the right ventricle. From there, blood is pumped through the pulmonary valve to enter the lungs. After being oxygenated, blood passes to the left atrium, where is it pumped through the mitral valve to the left ventricle. The left ventricle pumps blood to the aorta through the aortic valve.

There are many potential causes of heart valve damage, such as birth defects, age related changes, and effects from other disorders, such as rheumatic fever and infections causing endocarditis. High blood pressure and heart failure which can enlarge the heart and arteries, and scar tissue can form after a heart attack or injury.

The three main types of artificial heart valves are mechanical, biological (bioprosthetic/tissue), and tissue-engineered valves. In the US, UK and the European Union, the most common type of artificial heart valve is the bioprosthetic valve. Mechanical valves are more commonly used in Asia and Latin America.[citation needed] Companies that manufacture heart valves include Edwards Lifesciences, Medtronic, Abbott (St. Jude Medical), LivaNova, CryoLife, and LifeNet Health. Artificial heart valves are expected to last from 10 to 30 years. The most common problems with artificial heart valves are various forms of degeneration, including gross billowing of leaflets, ischemic mitral valve pathology, and minor chordal lengthening. The repairing process of the artificial heart valve regurgitation and stenosis usually requires an open-heart surgery, and a repair or partial replacement of regurgitant valves is usually preferred. Researchers are investigating catheter-based surgery that allows repair of an artificial heart valve without large incisions. An artificial heart valve should ideally function like a natural heart valve.[12] The functioning of natural heart valves is characterized by many advantages:

Minimal regurgitation – This means that the amount of blood leaking backwards through the valve as it closes is small. Some degree of valvular regurgitation is inevitable and natural, up to around 5 ml per beat.[32] However, several heart valve pathologies (e.g. rheumatic endocarditis) may lead to clinically significant valvular regurgitation. A desirable characteristic of heart valve prostheses is that regurgitation is minimal over the full range of physiological heart function. Minimal transvalvular pressure gradient – Whenever a fluid flows through a restriction, such as a valve, a pressure gradient arises over the restriction. This pressure gradient is a result of the increased resistance to flow through the restriction. Natural heart valves have a low transvalvular pressure gradient as they present little obstruction to the flow through themselves, normally less than 16 mmHg. A desirable characteristic of heart valve prostheses is that their transvalvular pressure gradient is as small as possible. Non-thrombogenic – Natural heart valves are lined with an endothelium comparable with the endothelium lining the heart chambers, so they are not normally

thrombogenic (i.e. they don't cause blood clots). Blood clots can be hazardous because they can lodge in, and block, downstream arteries (e.g. coronary arteries, leading to heart attack [myocardial infarction]; or cerebral arteries, leading to stroke). A desirable characteristic of artificial heart valves is that they are non- or minimally thrombogenic. Self-repairing – Valve leaflets retain some capacity for repair thanks to regenerative cells (e.g. fibroblasts) in the connective tissue from which the leaflets are composed. As the human heart beats approximately 3.4×109 times during a typical human lifespan, this limited but nevertheless present repair capacity is critically important. No heart valve prostheses can currently self-repair, but tissue-engineered valves may eventually offer such capabilities.[27]

---

2 Dental Microscope

Dental microsurgery involves the use of magnification and illumination for an enhanced visualization of anatomical details and fine structures. The dental microscope is an essential instrument used in dental procedures and dental surgery, allowing optimal assessment, preservation and maintenance of tooth structure and oral tissue, as well as minimally invasive procedures. Leica Microsystems offers cutting-edge Dental Surgical Microscopy solutions, combining world-renowned optics, optimal ergonomics and maneuverability, and ease of use to support dental professionals in achieving surgical excellence.

Applications of Dental Surgical Microscopy The use of microscopes in dental surgery has a wide range of applications, since it allows an enhanced visualization of fine anatomical details and tissue structures. By using higher magnification and seeing more, dental professionals can apply their skills more precisely and optimize their workflow. Some of the most common applications of Dental Surgical Microscopy, also referred to as micro-dentistry, include the following: Endodontics and endodontic surgery Periodontics and periodontal surgery Implantology Prosthodontics and aesthetic dentistry Restorative dentistry Oral surgery Routine dental techniques A dental microscope should provide optimal light intensity and depth of field, while achieving sufficient resolution when working in deep or narrow cavities, such as during root canal treatment.

In micro-dentistry procedures, it is essential to achieve optimal and precise control of dental instruments under high magnification to avoid damaging the dentine walls or other tissues.

Moreover, it is important to achieve visualization of anatomical details in vivid colors to ensure their correct differentiation, such as during removal of pathologic tissue during dental procedures or surgeries.

Maintaining a natural and comfortable working posture is another major challenge in dental microsurgery, as poor ergonomics can lead to significant stress and fatigue during lengthy procedures. A dental microscope supports the dentist during micro-invasive surgeries and other surgical procedures with the aim to preserve the tooth structure and conserve tissue, while minimizing the risks and reducing healing time. Dental microsurgery offers the following advantages:

Higher precision and accuracy, thanks to high magnification views with optimal depth perception and true-to-life colors Workflow efficiency under ergonomic conditions Improved patient care – microsurgery offers reduced risks and recovery time for patients, as well as better patient education using microscope images. Improved training and education due to integrated HD image and video recording. Improved documentation through transfer of images or videos to patient files. Our dental surgical microscopes provide world-class optics and powerful illumination, as well as enhanced ergonomic features to significantly improve your workflow in dental surgery. Leica dental microscopes M320, M525 and PROvido respond to the demands of a wide range of dental specialties, helping you work in comfort throughout your career. The dental microscope provides breakthrough visualization modes that introduce new applications to microdentistry. It is poised to revolutionize and differentiate your practice with: Augmented Visualization, Digital Patient Communication and Single-Handed Operation.

A dental microscope is an important tool that allows for better visualization through magnification of objects. In dentistry, microscopes enhance precision which not only enhances the quality of the dentists' work, but also helps ensure long-term dental health of the patient. For dentists, some of the primary goals include micro-invasive surgeries, minimizing risks and to reduce the overall healing time. As such, they have redefined the concept of visualization and have consequently become an essential element not only in dentist's armamentarium, but also as part of academic curriculum in endodontics.

In addition, some of the dental microscopes come with additional attachments such as camera and video equipment. This allows the dentists to engage with the patient more and allow them to not only see the extent of damage (if any) but also see the results. Here, the patients can feel involved and gain a better understanding of the procedure. Therefore, with dental microscopes, dentists will notice significant benefits.

---

3 Mobile CT

One of the great diagnostic tools created in the last 30 years is the computed tomography (CT) scanner, which has been enhanced over the years, with mobile capabilities.

In nutshell, a CT scanner is a system that combines a series of X-ray images from different angles around the body and then uses a computer to create cross-sectional images (aka slices) of the bones, blood vessels and soft tissues. The CT scanning procedure starts with the patient lying on a bed that moves slowly through a gantry while the X-ray tube rotates around the patient. Next, the CT scanner computer creates 2D images of the slice of the body that is being treated, typically ranging from 0.04 to 0.4 inches thick; and then combines the 2D images to create a 3D image of the body, providing considerably higher quality imaging in a shorter time than the standard X-ray machines. The results of the scan are ready within 15 to 30 minutes, enabling radiologists to review and interpret the scan as soon as it is completed.

The CT scanner can detect signs of inflammation, injury, or disease of various organs such as: the liver, spleen, kidneys, stomach, intestines, pancreas, and adrenal glands. It is also used to look at blood vessels and lymph nodes in the abdomen; and can show a tumor in the abdomen, as well as swelling in surrounding organs. In addition, it can detect lacerations of the spleen, kidney, and liver.

To prepare for the scan, the patient is infused with a dye solution (typically

iodine or barium) which works by altering how X-rays interact with body tissues and differentiate the abnormal tissues from the healthy tissues in the result image; thus, allowing doctors to provide the best course of action to treat the patients. The scanning process length depends on the organ scanned, and it takes more time to get the patients in the right position and inject the dye than to process the actual scanning. A CT scan is a painless exam; however, patients who receive intravenous contrast dye (IVP dye) may experience a warm sensation, metallic taste and/or feeling of urination, as well as itching and mild skin rash or hives. The dye stays in the patient's system for 24 hours, unless the patient has a kidney malfunction, in which case it is likely to stay longer.

It is important to note that fixed CT scanners are massive machines weighing up to 4,000 kilograms that rely on high-voltage capacities and cooling machinery. However, there are some situations such early care of stroke patients, battlefield victims or in medical emergency rooms when fixed CT scanner are just too cumbersome to be used efficiently. The immobility of CT scanning machines and the lack of convenient access to CT scans is a huge impediment when dealing with patients for whom speed of treatment is critical; specifically, patients with stroke or brain injuries. This is where Mobile CT scanning units fit in: they bring the hospital to the patients. Mobile CT scanners are CT scanning systems on wheels meant to be moved easily from room to room. The first mobile CT scanner was launched around 1970 by Medical Coaches Inc, with their founder Ian Smith in a deal with Peru1. The Medical Coaches CT scanner was primarily focused on head scans as well as cross-sectional images of the heart. Over the years, the CT scanners technology improved and provided higher quality multi-functional imaging, while facilitating the transport to the patients point of care. Mobile CT systems are designed for patient safety and faster accurate results; they also allow the machine to be transported into patients' rooms for procedures to be done at the bedside, rather than transporting patients to radiology departments; thus cutting the need for patients and medical personnel to travel to a separate room for CT scanning. Mobile imaging is evolving and gaining more widespread usage throughout the healthcare industry, the use of Mobile CT scanners and MRI scanners has been increasing over time due to the improvements in economic development of many countries, as well as the technological advancement for CT imaging in hospitals. When compared to fixed CT scanners, mobile CT's were found to have very positive outcomes including:

reduction in time of receiving diagnostic services; enhancement of the patients' recovery; reduction in total length of stay at the hospital; higher accuracy in patient management; as well as increased access and responsiveness to the patients' needs2. A key point is the mobile CT's ability to perform imaging and to treat a patient without repositioning and by reducing the patients' movements; which helps provide more accurate diagnosis. The incidence of adverse events, while transporting critically ill patients for CT imaging is as high as

71

4 Retinal Camera

Retinal imaging takes a digital picture of the back of your eye. It shows the retina (where light and images hit), the optic disk (a spot on the retina that holds the optic nerve, which sends information to the brain), and blood vessels. This helps your optometrist or ophthalmologist find certain diseases and check the health of your eyes.

Doctors have long used a tool called an ophthalmoscope to look at the back of your eye. Retinal imaging allows doctors to get a much wider digital view of the retina. It doesn't replace a regular eye exam or regular dilation,, but adds another layer of precision to it.

Your doctor may recommend it if you have any the following diseases or conditions:

Diabetes: This disease can damage the blood vessels in your retina. Over time, it causes you to lose your sight if it is not controlled.

Macular degeneration: The central part of your retina (the macula) starts to get worse with age. You may have blurry vision and find it harder to focus. If that happens, you may be considered legally blind even though you may still have peripheral vision. There are two kinds of macular degeneration: wet and dry.

Dry macular degeneration is by far the most common form of this disease (up to 90

Abnormal blood vessels growing under the retina cause wet macular degeneration. Vision loss is usually fast.

Retinal imaging is very important in finding this type of macular degeneration.

Glaucoma: This disease damages your optic nerve (located in the retina) and may cause vision loss. It typically happens when fluid builds up in the front of your eye. It can cause blindness but it normally progresses slowly and can be treated with special eye drops to lower the pressure caused by the fluid. Retinal imaging allows eye doctors to see signs of eye diseases that they couldn't see before. The test itself is painless and the results are easy for doctors to interpret. Your doctor can store the images on a computer and compare them with other scans.

Retinal imaging has its limitations. It can't detect a disease where the retina is bleeding. It also may not see problems on the outer edges of your retina.

Retinal imaging may be covered by your medical insurance (not your vision insurance) or Medicare. It depends on the terms of your policy as well as the reason you are having the test done. When we refer to Retinal Camera, we are talking about the medical imaging device. It is usually worn on the eye itself or may be placed in a particular area for the purpose of taking retinal images of your retina. The Retinal Camera is a useful medical tool that enables us to see with clarity the back part of our eyeballs.

Fundus photography implies photographing the back of the eye; hence called the fundus. Different specialized lens equipped fundus cameras usually consisting of a multifocal microscope attached to a digital camera enable simultaneous image viewing. The instrument uses reflected light coming from the eye to create an image. The images are then digitized and displayed on a monitor. You can use this to diagnose your eye problem.

If you need to know what is Retinal Camera, you will be glad to know that it was invented by Dr. Harryvan van Sloten. This instrument was used to take close up photographs of newborn babies with very poor eyesight. It was Dr. van Sloten's wish to make an instrument that could enable people in need of seeing clearly the back part of their eyeballs. What he did was to develop the technology of using a simple camera inserted in the eye to take retinal images. These images are then shown on a monitor for you to view.

There is a new type of camera available in the market called Flash photography that is more precise than the conventional camera. What this special camera does is to capture images even when there is low light. In fact these images capture light as well as heat equally well. You can see these images in real time as well.

The digital camera is not only a medical tool but a fashion statement. The digital camera works with infrared or light sensors. This sensor enables the

camera to see in the dark. Normally the human eye is equipped with mechanisms to detect light but it is unable to distinguish between light and darkness. In such circumstances it is unable to capture images. This type of camera is capable of doing this job extremely well.
When you are using a digital camera, you will discover that it is actually much like the retinal camera. The difference being that the retinal camera only is able to show pictures taken with the help of its laser focuser to the digital one use the detectors to focus light onto the retina. When the light is focused onto the retina, it causes the images to be captured digitally and this is what is retinal camera does.

5 Stress Test System

Stress testing (sometimes called torture testing) is a form of deliberately intense or thorough testing used to determine the stability of a given system, critical infrastructure or entity. It involves testing beyond normal operational capacity, often to a breaking point, in order to observe the results. Stress testing, in general, should put computer hardware under exaggerated levels of stress in order to ensure stability when used in a normal environment. These can include extremes of workload, type of task, memory use, thermal load (heat), clock speed, or voltages. Memory and CPU are two components that are commonly stress tested in this way.
There is considerable overlap between stress testing software and

benchmarking software, since both seek to assess and measure maximum performance. Of the two, stress testing software aims to test stability by trying to force a system to fail; benchmarking aims to measure and assess the maximum performance possible at a given task or function.

When modifying the operating parameters of a CPU, such as temperature, overclocking, underclocking, overvolting, and undervolting, it may be necessary to verify if the new parameters (usually CPU core voltage and frequency) are suitable for heavy CPU loads. This is done by running a CPU-intensive program for extended periods of time (usually 24 hours for home PC), to test whether the computer hangs or crashes. CPU stress testing is also referred to as torture testing. Software that is suitable for torture testing should typically run instructions that utilise the entire chip rather than only a few of its units. Stress testing a CPU over the course of 24 hours at 100Unvalidated stress tests are not advised (such as Prime95 or LinX or other comparable applications). For high grade CPU/IMC and System Bus testing AIDA64 is recommended along with general applications usage like PC Mark 7. Aida has an advantage as its stability test has been designed for the Sandy Bridge E architecture and test specific functions like AES, AVX and other instruction sets that prime and like synthetics do not touch. As such not only does it load the CPU 100

A stress test, also known as an exercise test or treadmill test, can give an idea of how well a person's heart works during physical activity. It can also help diagnose various heart conditions.

A stress test typically involvesTrusted Source walking on a treadmill or using a stationary cycle while medical devices monitor breathing, blood pressure, heart rate, and heart rhythm.

Some people, such as those with arthritis, may not be able to do the activities involved in an exercise stress test. Instead, a doctor will give these people a drug to make their heart work harder, as it might during exercise. In this article, learn why a doctor may recommend a stress test and what to expect during one. If a person cannot exercise, the doctor may use a certain medication to trigger the same process. In this case, they will attach electrodes to the person's chest and deliver the medication into their arm through an IV line. The medication will take 15–20 minutes to deliver. The medication will stimulate the heart. It may cause effects similar to those that occur during exercise, such as flushing or shortness of breath. Doctors ask people to exercise at 85Doctors may look at how well a person's heart rate recovers after exercise. To measure this, they can subtract the heart

rate one minute after exercise from the peak heart rate. If a person's heart rate has dropped significantly, they have shown an easy recovery.

The laboratory must have basic equipment such as a 12-lead ECG, blood pressure monitoring capacity, a treadmill or bicycle for ergometry, a precision intravenous delivery system for pharmacological stress testing as well as an adequate echo table; additionally, emergency equipment is mandatory. A stress test, also called an exercise stress test, shows how your heart works during physical activity. Because exercise makes your heart pump harder and faster, an exercise stress test can reveal problems with blood flow within your heart.

A stress test usually involves walking on a treadmill or riding a stationary bike while your heart rhythm, blood pressure and breathing are monitored. Or you'll receive a drug that mimics the effects of exercise.

Your doctor may recommend a stress test if you have signs or symptoms of coronary artery disease or an abnormal heart rhythm (arrhythmia). If your stress test results suggest that you might have coronary artery disease or show an arrhythmia, your doctor will use the information to develop a treatment plan. You may need additional tests, such as a coronary angiogram.

If you had a stress test to help determine treatment for a heart condition, your doctor will use the results to plan or change your treatment.