Federal Democratic Republic of Ethiopia
Ministry of Health

OPHTHALMIC EQUIPMENT'S TRAINING COURSE FOR BIOMEDICAL

PARTICIPANT'S MANUAL

January, 2019

Pharmacy and Medical Equipment Management Directorate

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Forward

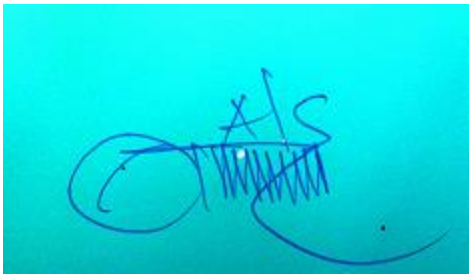
Modern health care services are very much dependent on the use of proper medical devices for diagnosis and treatment. The majority of these devices and equipment are manufactured in developed countries and needs skilled man power to manage and use them lifelong. Because they are applied on human being they need rigorous care and handling for the sake of patient safety and utilize them effectively and efficiently. Even with normal and careful use, they are subject to malfunction.

It is important to take good care of them and employ timely preventive maintenance to keep them working last long and decrease downtime. The proper handling and maintenance of these devices can be achieved by deploying the well trained and competent biomedical Equipment Engineers/ Technicians to the respective health facilities. In line with this, it is also important to provide continuous on job training to build their capacity and introduce them to a new technology. Therefore, this training package is developed to provide TOT for biomedical education training provider institute instructors as well as professional who are working at health facilities to fill their Knowledge, attitude and skill gaps on some selected ophthalmic medical devices.

APPROVAL STATEMENT OF THE MINISTRY

The Federal Ministry of health of Ethiopia has been working towards standardization and institutionalization of In-Service Trainings (IST) at national level. As part of this initiative the ministry developed a national in-service training directive and implementation guide for the health sector. The directive requires all in-service training materials fulfill the standards set in the implementation Guide to ensure the quality of in-service training materials. Accordingly, the ministry reviews and approves existing training materials based on the IST standardization checklist annexed on the IST implementation guide.

As part of the national IST quality control process, this ophthalmic equipment IST training package has been reviewed based on the standardization checklist and approved by the ministry in June , 2019.



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List of acronyms and abbreviations

AAU IT Addis Ababa University Institute of Technology

AAT PC Addis Ababa Tegbare-id Polytechnique College

HBC Human Bridge College

KPTC Kombolcha Polytechnique College

HTM Health Technology Management

CCD Charge Coupled Devices

IOP Inter ocular pressure

IPD Inter-Pupillary Distance

JUIT Jimma University Institute of Technology

ND No Diopters (an intermediate position b/n the diopters)

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Introduction to the Manual

The Federal Ministry of Health's Growth and Transformation Plan (GTP) indicates that by 2018, 16 specialized governmental hospitals, 80 general hospitals, 800 primary hospitals, and 3,200 health centers will be established. Additionally, there are more than 200 private hospitals and diagnostic centers operating in the country. The FMoH reports that these healthcare facilities will need 4,000 newly trained biomedical equipment technicians and 600 biomedical engineers. Ensuring that existing technicians and engineers are equipped with adequate skills is also a challenge. Ethiopia lacks systems to manage the lifecycle of emerging healthcare technologies and medical devices, but has developed a plan to address this.

The current biomedical engineering programs at JUIT and AAUIT, and the vocational biomedical technician program at AATPC, HBC, KPC and other newly merging regional TVET Colleges are tasked with producing technicians and engineers to meet the very high demands for trained professionals throughout Ethiopia. Program gaps include a lack of adequate hands-on, practical training opportunities and laboratory/ industrial skills for students, and acute shortage of academically/industrially/vocationally trained faculty and staff. The existing faculty and staff lack access to modern biomedical training equipment, modern training methodologies, as well as evidence-based information on biomedical devices that is in line with international standards and best practices. This deprives students/trainees of standardized protocols and training in devices maintenance and management and leads to an unstructured career path for students.

The HRH Project through its close working relation with those institutes has made discussions with teaching staff's and biomedical departments to gather the information regarding the training demand and discussed with the FMoH, HR directorate and decided to develop these standard training packages for the purpose of conducting technical update training on some selected medical devices. The HRH project, Core biomedical Engineers coordinate this training package development activity in collaboration with FMoH technical experts, we hope this will be a good opportunities for faculty, staff, and HTM personnel's to fill the skill gap on the selected medical devices and as a result improves the faculty teaching learning process.

THE FOLLOWING ARE THE CORE COMPETENCE OF THIS TRAINING MANUAL.

- Explain the operation principles of some selected ophthalmic medical devises
- Identify the basic components of the selected ophthalmic medical devises
- Apply the proper handling and safe use of ophthalmic medical devices
- Perform appropriate troubleshooting procedures for each equipment/devices.
- Perform preventive and corrective maintenance as per the manufacturer manual
- Perform performance test and calibration as demanded

Course syllabus

COURSE DESCRIPTION

This 4 days training is designed for participants to provide with knowledge, skill and attitude to maintain ophthalmic equipment (Operation Microscope, Slit Lamp, Tonometer & other Ophthalmic Equipment). Upon completion of this course, trainees will have the required knowledge and skills to maintain ophthalmic equipment by applying the standard principles of preventive and corrective maintenance in safe and efficient manner.

COURSE GOAL:

To provide participants with the knowledge, skill and attitude needed to maintain ophthalmic equipment. (Operation Microscope, Slit Lamp, Keratometer, Tonometerand ophthalmoscope)

PARTICIPANT LEARNING OBJECTIVES:

At the end of the course, the trainee will be able to:

- Describe the Purpose of Operation Microscope, Slit Lamp, Keratometer, Tonometer& ophthalmoscope
- Explain working principle of Operation Microscope, Slit Lamp, Keratometer, Tonometer & ophthalmoscope
- Explain clinical applications of Operation Microscope, Slit Lamp, Keratometer, Tonometer & ophthalmoscope
- Identify and explain the functions of each parts
- Prepare the required tools, Instruments and materials for maintenance work
- Perform preventive maintenance for Operation Microscope, Slit Lamp, Keratometer, Tonometer & ophthalmoscope according to the manufacturers instruction
- Perform Corrective maintenance for Operation Microscope, Slit Lamp, Keratometer, Tonometer & ophthalmoscope according to the manufacturers instruction
- Follow OSH policies and procedures according to manufacturer's specifications.

TRAINING/LEARNING METHODS

- Interactive lectures
- Group discussion
- Group Exercises./work
- Demonstration and coaching
- Video and simulation
- Role play and modeling
- Facility visit with mentoring

TRAINING MATERIAL

- Participant manual
- Facilitators' guide

- check list
- Power point presentation (LCD & Laptop)
- Colored markers
- Flip chart/white board
- Video shows
- Trainee's manuals
- Service manuals
- WHO maintenance guide lines
- Selected Ophthalmic equipment/devices
- E-learning materials
- Simulators
- Tool kits
- Notebook

PARTICIPANT SELECTION CRITERIA

•Participant for this course should be biomedical engineers/ technicians and registered professional working on medical device maintenance

TRAINERS' SELECTION CRITERIA

The facilitators of this course will be:-

- consultants (TWG) who have developed the course
- Who has minimum of BSc Degree in Biomedical Engineering
- Who has the relevant practical experience on ophthalmic devices preferably at Health facility;
- TOT on Ophthalmic Equipment.
- Basic training on Ophthalmic Equipment with Training Facilitation skill.

METHOD OF EVALUATION

Participant

FORMATIVE

- Pre-test
- Group exercises/ demonstration using checklists

SUMMATIVE

- Knowledge assessment (30 %)
- Practical assessment (70%)

COURSE

- Daily evaluation
- End of course evaluation

CERTIFICATION CRITERIA

- Trainees who has completed and pass (score 70 % & above) the end of course performance evaluation will be provided certificate of participation/completion.
- 100% of attendance
- Post test score more than 70% for basic training and 80% for TOT.

COURSE DURATION (4 DAYS)

- For slit lamp four sessions in two days (12 hrs).
- For Applanation Tonometer 1 sessions in ½ a day (2 hrs).
- For operation microscope two sessions in 1 day (8 hrs).
- For other ophthalmic equipment (ophthalmoscope, Keratometer and Lensometer) two sessions in one days (8 hrs).

COURSE COMPOSITION

- Suggested training class size: shall not be more than 25 participants per training venue. Four trainers each staying for the whole duration of the training are needed for each training session.

COURSE VENUE

- Accredited in-service training centers with functional internet service and With convenient facilities
  (Equipment for practice preferably hospitals)

Course Schedule

Training Course on Ophthalmic Equipment's for Biomedical

Organized by: _____

Venue: _____ Date: _____

Day One

TIME	TOPIC	DURATION	FACILITATOR/S NAME
8:30-9:00 am	Registration	60min	
9:00-9:30 am	Welcoming Address/Opening Speech	15min	
9:30-9:45 am	Introductory activities	10min	
9:45 -10:15 am	Pre test	35min	
10:15-10:30 am	Tea Break	15min	
10:30-12:30	Chapter 1:CRC	120min	
12:30-1:30 pm	Lunch Break	60min	
1:30-3:00 pm	Chapter 2: Slit Lamp	90min	
3:00-3:15 pm	Tea Break	15min	
3:15-5:20 pm	Chapter 2: Slit Lamp	125min	
5:20-5:30 pm	Chapter 2: Slit Lamp	10min	

Day Two

TIME	TOPIC	DURATION	FACILITATOR/S NAME
8:30-8:45 am	Recap of Day One	15min	Participants
8:45-10:00am	Chapter 2: Slit Lamp	75min	
10:00-10:15 am	Tea Break	15min	
10:15 -12:30pm	Chapter 2: Slit Lamp	135min	
12:30-1:30 pm	Lunch Break	60min	
1:30-2:20 pm	Chapter 2: Slit Lamp	50min	
2:20-4:30 pm	Chapter 2: Slit Lamp	130min	
4:30-4:45 pm	Tea Break	15min	
4:45-5:30 pm	Chapter 3: Tonometer	45min	

Day Three

TIME	TOPIC	DURATION	FACILITATOR/S NAME
8:30-9:00 am	Recap of Day 2	30min	Participants
9:00-10:00 am	Chapter 3: Tonometer	60min	
10:00-10:15 am	Tea Break	15min	
10:15-12:30 am	Chapter 4:Operation Microscope	135min	
12:30-1:30 pm	Lunch Break	60min	
1:30-4:30 pm	Chapter 4:Operation Microscope	180min	
4:30-4:45 pm	Tea Break	15min	
4:45-5:30 pm	Chapter 4:Operation Microscope	45min	

Day Four

TIME	TOPIC	DURATION	FACILITATOR/S NAME
8:30-9:00 am	Recap of Day 3	30min	Participants
9:00-10:00 am	Chapter 5:Keratometer	60min	
10:00-10:15 am	Tea Break	15min	
11:15-12:30 am	Chapter 5:Keratometer	75min	
12:30-1:30 pm	Lunch Break	60min	
1:30-4:30pm	Chapter 5:Keratometer	180min	
4:30-4:45 pm	Tea Break	15min	
4:45-5:20 pm	Post Test	35min	
5:20-5:30 pm	Closing	10min	

Chapter 1:

Caring, Respectful and Companionate Healthcare Service

CHAPTER DESCRIPTION:

This chapter is designed to equip healthcare professionals and senior management in health facilities to increase core competencies of compassionate, respectful, holistic, scientifically and culturally acceptable care for patients and their families.

CHAPTER OBJECTIVE:

By the end of this chapter the participants will be able to:

- Describe Compassionate, respectful and Caring (CRC) healthcare service delivery

ENABLING OBJECTIVES:

By the end of this chapter participants will be able to:

- Describe Compassionate, respectful and caring (CRC)
- List principles of health care Ethics
- Discuss components of compassionate care
- Explain principles of respectful care
- Discuss characteristics of Compassionate leader

CHAPTER OUTLINE

1.1. Introduction to CRC
1.2. Healthcare Ethics
1.3. Compassionate care
1.4. Respectful care
1.5. Compassionate leader
1.6 Summery

1.1. INTRODUCTION TO COMPASSIONATE, RESPECTFUL AND CARING (CRC)

Activity 1.1: Individual reflection

• What are Compassionate, Respect and Caring (CRC)?

Time Allowed 15 minutes

1.1.1. DEFINITION OF CRC

Compassion (ሩህሩህ)

Is a feeling of deep sympathy and sorrow for the suffering of others accompanied by a strong desire to alleviate the suffering? Therefore, we can say it is being sensitive to the pain or suffering of others and a deep desire to alleviate the suffering.

Respectful (ተገልጋይንየሚያከብር)

Is the kind of care, in any setting, which supports and promotes, and does not undermine a person's self-respect, regardless of any differences?

Caring (ተንከባካቢ)

Caring is an intensification of the affective dimension of empathy in the context of significant suffering. It is coupled with effective interventions to alleviate that suffering.

Compassionate, respectful and Caring (CRC) -

Means serving patients, being ethical, living the professional oath, and being a model for young professionals and students. It's a movement that requires champions who identify with their profession and take pride by helping people.

•Why CRC a transformational agenda?

Time Allowed 10 minutes

1.1.2. WHY CRC A TRANSFORMATION AGENDA?

Helping health professionals' to become compassionate and respectful practitioners remains a major challenge for the healthcare. Compassionate and respectful care is not only morally and financially essential, but it is required in many countries through national legislation and/or national health policy. The notion that healthcare services must be expanded beyond the prevention of morbidity or mortality is only one aspect of the agenda. It must encompass respect for patients' basic human rights, including respect for patients' autonomy, dignity, feelings, choices, and preferences. It must include choice of companionship wherever possible.

Taken from the United Nations human rights declaration, ‘All human beings are born free and equal in dignity and rights.’ The Ethiopian constitution of human rights article 25 and 26 states that the rights to equality and privacy.

In the Ethiopian health system, there are many health professionals who have dedicated their entire career to public service and are respected by the public they serve. However, a significant proportion of health professionals see patients as just ‘cases’ and do not show compassion. Lack of respect to patients and their families is also a common complaint.

39 complaints were related to death of the patient and 15 complaints were about disability. The committee verified that 14 of the 60 claims had an ethical breach and/or negligence and other study also indicated that forwarding bad words, shouting on patients, mistreatment, insulting and hitting of clients are some of unethical practices showed by the health professionals.

STUDIES SHOWED THE NEED FOR CRC

- Lack of role models in many health facilities.
- Measuring the worth of a profession by how much it pays.
- Senior physicians cancel their outpatient clinics without informing their patients.
- Elective surgeries get cancelled.
- Admitted patients are by default getting the care they need from relatives.
- Nurses, for various reasons, have limited their role to providing injections and securing IV lines.
- Proper counseling during dispensing of drugs is also becoming a rarity.
- The quality of lab tests and the quality assurance process that lab professionals have to take before issuing results is not practiced as expected.
- Lack of compassion, respect and care is the common source of grievances in health facilities.

A three-year report of the Ethics Committee and relevant documents in Addis Ababa showed that.

1.1.3. THE BENEFITS OF CRC

Table 1.The benefits and beneficiaries of Compassionate and Respectful Care

Beneficiaries	Who	How
First	Patients	• When health professionals are compassionate, patients are less anxious • Adherence to medical advice and treatment plans • Compassionate care correlates positively with both prevention and disease management. Diabetic patients, for example, demonstrate higher self-management skills when they self-report positive relationships with their providers • Hostile emotional states in patients delay the healing processes • Quality of health professionals –patient communication with increased physical functioning, emotional health and decreased physical symptoms of pain in patients
Second	Health Professionals	• Health care Professionals satisfaction with their relationships with patients can protect against professional stress, burnout, substance abuse and even suicide attempts • Burnout is strongly associated with poorer quality of care, patient dissatisfaction, increased medical errors, lawsuits and decreased expressions of compassion • Participation in a mindful communication associated with short-term and sustained improvement in well-being and attitudes associated with patient care • A major predictor of patient loyalty • When health professionals are compassionate, they achieve earlier and more accurate diagnoses because the patient is better able to reveal information when he or she feels emotionally relaxed and safe • Respect from the client/patients • Health professionals will find their work more meaningful and gratifying
Third	Students	• Good role modeling is essential for students • Increased motivation to be CRC health professionals
Fourth	Health care facilities	• Patient satisfaction will rise • Quality of health care will be improved • Lower malpractice suits • Staff will be more loyal to their hospital or health care system • Patient adherence to treatment will rise • Resources can be conserved • Greater employee satisfaction and reduced employee turnover.

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1.1.4. NATIONAL STRATEGY AND APPROACH OF CRC

The development of caring, respectful and compassionate health workers requires a multi-pronged approach in order to make CRC as a culture, self-driven inner motive and a legacy that the current generation of practitioners leaves to their successors.

NATIONAL STRATEGY AND APPROACHES FOR CRC

- Reforming the recruitment of students for health science and medicine programs.
- Improving the curriculum of the various disciplines.
- Ownership and engagement of the leadership at all levels of the system.
- Inspirational leadership that aims to create an enabling environment.
- National, regional and facility level ambassadors.

- An advocacy campaign through mass media will also be launched to project positive images of health professionals.
- Patients and the general public will also be engaged in this movement.
- An annual health professional recognition event will be organized
- Putting in place a favorable legislative framework to reinforce CRC which would include regulation on patients' rights and responsibilities (PRR)
- Measurement of health care providers on CRC
- Comprehensive projects will be designed.
- Conducting national assessment related to CRC.
- Provision of continuous CRC trainings.
- Engagement and ownership of professional associations.
- Experience sharing from national and international best practices.

1.2. HEALTHCARE ETHICS

1.2.1. PRINCIPLES OF HEALTH CARE ETHICS

Individual reflection
❖What is ethics?
❖What is health care ethics?
Time: 5 Minutes

Ethics:

Ethics is derived from the Greek word ethos, meaning custom or character. Ethics is the study of morality, which carefully and systematically analyze and reflect moral decisions and behaviors, whether past, present or future. It is a branch of philosophy dealing with standards of conduct and moral judgment.

Health care ethics:

It is a set of moral principles, beliefs and values that guide us to make choices about healthcare. The field of health and healthcare raises numerous ethical concerns, including issues of health care delivery, professional integrity, data handling, use of human subjects in research and the application of new techniques.

Ethical principles are the foundations of ethical analysis because they are the viewpoints that guide a decision. There are four fundamental principles of healthcare ethics.

1. Autonomy
2. Beneficence
3. Non-maleficence
4. Justice

1. AUTONOMY

Autonomy is the promotion of independent choice, self-determination and freedom of action. Autonomy implies independence and ability to be self-directed in one's healthcare. It is the basis of self-determination and entitles the patient to make decisions about what will happen to his or her body.

Case one:
A 49-year-old client with diabetic finding came with right foot second finger gangrene to a hospital. The surgeon decided that the finger should be removed immediately. But the patient refused the procedure.
Question: How should the surgeon handle this case?
Time: 5 Minutes

2. BENEFICENCE

Beneficence is the ethical principle which morally obliges health workers to do positive and rightful things. It is "doing what is best to the patient". In the context of professional-patient relationship the professionals are obliged to always and without exception, favor the wellbeing and interest of their patients.

Case two:
Ms. X was admitted to adult surgical ward with severe excruciating right flank pain with presumptive diagnosis of renal colic. Nurse Y was the duty nurse working that day. The physician who saw her at OPD did not write any order to alleviate the pain.
Question: What should the attending nurse do for Ms. X?
Time: 5 Minutes

3. NON-MALEFICENCE

The principle refers to "avoid doing harm". Patient can be harmed through omitting or committing interventions. When working with clients, healthcare workers must not cause injury or distress to clients. This principle of non-maleficence encourages the avoidance of causing deliberate harm, risk of harm and harm that occurs during the performance of beneficial acts. Non-maleficence also means avoiding harm as consequence of good.

Case Three:
Mr "X" is admitted to internal medicine ward with cardiac failure. The physician admitted Mr "X" and prescribed some medication which should be given regularly by the ward nurse. A nurse in charge of the ward does not give a patient medication timely and appropriately.
Question: What should the ward nurse do for Mr "X"
Time: 5 Minutes

4. JUSTICE

Justice is fair, equitable and appropriate treatment. Justice refers to fair handling and similar standard of care for similar cases; and fair and equitable resource distribution among citizens. It is the basis for treating all clients in an equal and fair way. A just decision is based on client need and fair distribution of resources. It would be unjust to make such decision based on how much he or she likes each client.

Example:

- Resource scarcity is the common issue in healthcare settings. For example, there may be only one or two neurosurgeons and many patients on the waitlist who need the expertise of these neurosurgeons. In this case we need to serve patients while promoting the principle of justice in transparent way. Example, the rule of first come first serve could be an appropriate rule.
- Justice requires the treatment of all patients equally, irrespective of their sex, education, income or other personal backgrounds.

1.2.2. CONFIDENTIALITY AND INFORMED CONSENT.

CONFIDENTIALITY

Confidentiality in healthcare ethics underlines the importance of respecting the privacy of information revealed by a patient to his or her health care provider, as well the limitation of healthcare providers to disclose information to a third party. The healthcare provider must obtain permission from the patient to make such a disclosure.

The information given confidentially, if disclosed to the third party without the consent of the patient, may harm the patient, violating the principle of non-maleficence. Keeping confidentiality promotes autonomy and benefit of the patient.

THE HIGH VALUE THAT IS PLACED ON CONFIDENTIALITY HAS THREE SOURCES:

- **Autonomy:** personal information should be confidential, and be revealed after getting a consent from the person
- **Respect for others:** human beings deserve respect; one important way of showing respect is by preserving their privacy.
- **Trust:** confidentiality promotes trust between patients and health workers.

THE RIGHT OF PATIENT TO CONFIDENTIALITY

- All identifiable information about a patient's health status, medical condition, diagnosis, prognosis and treatment and all other information of a personal kind, must be kept confidential, even after death. Exceptionally, family may have a right of access to information that would inform them of their health risks.

- Confidential information can only be disclosed if the patient gives explicit consent or if expressly provided for in the law. Information can be disclosed to other healthcare providers only on a strictly
  "Need to know" basis unless the patient has given explicit consent.
- All identifiable patient data must be protected. The protection of the data must be appropriate to the manner of its storage. Human substances from which identifiable data can be derived must also be protected.

EXCEPTIONS TO THE REQUIREMENT TO MAINTAIN CONFIDENTIALITY

- Routine breaches of confidentiality occur frequently in many healthcare institutions. Many individuals (physicians, health officers, nurses, laboratory technicians, students, etc) require access to a
  Patient's health records in order to provide adequate care to that person and, for students, to learn how to practice care provision.
- Care providers routinely inform the family members of a deceased person about the cause of death. These breaches of confidentiality are usually justified, but they should be kept to a minimum and those who gain access to confidential information should be made aware of the need not to spread it any further than is necessary for descendants benefit. Where possible, patients should be informed ahead that such a breach might occur.
- Many countries have laws for the mandatory reporting of patients who suffer from designated diseases, those deemed not fit to drive and those suspected of child abuse. Care providers should be aware of the legal requirements to be able to disclose patient information. However, legal requirements can conflict with the respect for human rights that underlies healthcare ethics. Therefore, care providers should look carefully at the legal requirement to allow such an infringement on a patient's confidentiality and assure that it is justified.

Case four:
An HIV-positive individual is going to continue to have unprotected Sexual intercourse with his spouse or other partners. **Question:**
1. How do you manage such an individual?
2. Discuss situations that breach confidentiality.
Time: 5 Minutes

Ethiopia Council of ministers' regulation 299/2013, Article 77 Professional Confidentiality

INFORMED CONSENT

Informed consent is legal document whereby a patient signs written information with a complete information about the purpose, benefits, risks and other alternatives before he/she receives the care intended. It is a body of shared decision making process, not just an agreement. Patient must obtain and being empowered with adequate information and ensure that he/she participated in their care process.

For consent to be valid, it must be voluntary and informed, and the person consenting must have the capacity to make the decision. These terms are explained below:

A. Voluntary: the decision to either consent or not to consent to treatment must be made by the person him or herself, and must not be influenced by pressure from medical staff, friends or family. This is to promote the autonomy of the patient.

B. Informed: the person must be given all of the information in terms of what the treatment involves, including the benefits and risks, whether there are reasonable alternative treatments and the consequences of not doing the treatment. This will help to avoid harm—patients may harm themselves if they decide based on unwarranted and incorrect information.

C. Capacity: the person must be capable of giving consent, which means they understand the information given to them, and they can use it to make an informed decision.

GENERAL PRINCIPLE OF INFORMED CONSENT

Should be given by a patient before any medical treatment is carried out. The ethical and legal rationale behind this is to respect the patient's autonomy and their right to control his or her life. The basic idea of personal autonomy is that everyone's actions and decisions are his or her own.

The principles include:

1. Information for patients
2. Timing of consent process
3. Health Professionals responsibility for seeking consent
4. Decision making for incompetent patients
5. Refusal of treatment

Ethiopia Council of minister's regulation 299/2013, Article 52. Patient's informed consent

1.2.3. PREVENTIVE ETHICS IN THE ASPECT OF CRC

WHAT IS PREVENTIVE ETHICS?

Preventive Ethics is a systematic application of ethical principles and values to identify and handle ethical quality gaps, dilemmas, challenges and errors to appropriately and fairly. It could be carried out by an individual or groups in the health care organization to identify prioritize and systematic address quality gaps at the system level.

WHY IS PREVENTIVE ETHICS IMPORTANT FOR CRC HEALTHCARE WORKERS?

First and foremost, the CRC health workforce, patients, families and the community at large should have a common understanding that the experience of illness and the practice of medicine lead to situations where important values and principles come to conflict and ethical dilemmas and challenges arise everywhere. Moreover, the CRC health worker should always understand the context in which She/he operates (like the services, the clients, the providers, values, norms, principles, culture, religions, socio-economic-geographic…) as the way in which ethical dilemmas are handled vary from case to case and place to place.

Preventive ethics helps the CRC health workforce to predict, identify, analyze, synthesize and manage ethical dilemmas, challenges and errors to make the appropriate and fair decisions. Hence, preventive ethics enhances honesty and transparency between healthcare workers, patients, families and relevant others to make a deliberated joint decision. Moreover, it inspires mutual understanding and trust amongst the healthcare provider, recipient and the community at large.

Preventive ethics brings all efforts together productively and leads to the satisfaction of clients, providers and the community even if when the decisions are sometimes painful and outcomes are negative.

1.2.4. ETHICS AND LAW AS ENABLERS OF CRC

THE RELATION BETWEEN ETHICS AND LAW

Individual reflection

- What is the relationship between ethics and law?

Time: 5 Minutes

ETHICS as discussed in the previous sessions, is considered as a standard of behavior and a concept of right and wrong beyond what the legal consideration is in any given situation.

LAW is defined as a rule of conduct or action prescribed or formally recognized as binding or enforced by a controlling authority. Law is composed of a system of rules that govern a society with the intention of maintaining social order, upholding justice and preventing harm to individuals and property. Law systems Are often based on ethical principles and are enforced by the police and Criminal justice systems, such as the court system.

Ethics and law support one another to guide individual actions; how to interact with clients and colleagues to work in harmony for optimum outcome; provision of competent and dignified care or benefits of clients/ patients. Ethics serves as fundamental source of law in any legal system; and Healthcare ethics is closely related to law. Though ethics and law are similar, they are not identical.

Often, ethics prescribes higher standards of behavior than prescribed by law; and sometimes what is legal may not be ethical and health professionals will be hard pressed to choose between the two. Moreover, laws differ significantly from one country to another while ethics is applicable across national boundaries.

The responsibilities of healthcare professionals and the rights and responsibilities of the patient is stipulated in legal documents of EFMHACA like regulation 299/2013, directives and health facility standards.

1.3. PRINCIPLES AND STANDARDS OF COMPASSIONATE CARE

1.3.1. QUALITIES OF COMPASSIONATE CARE

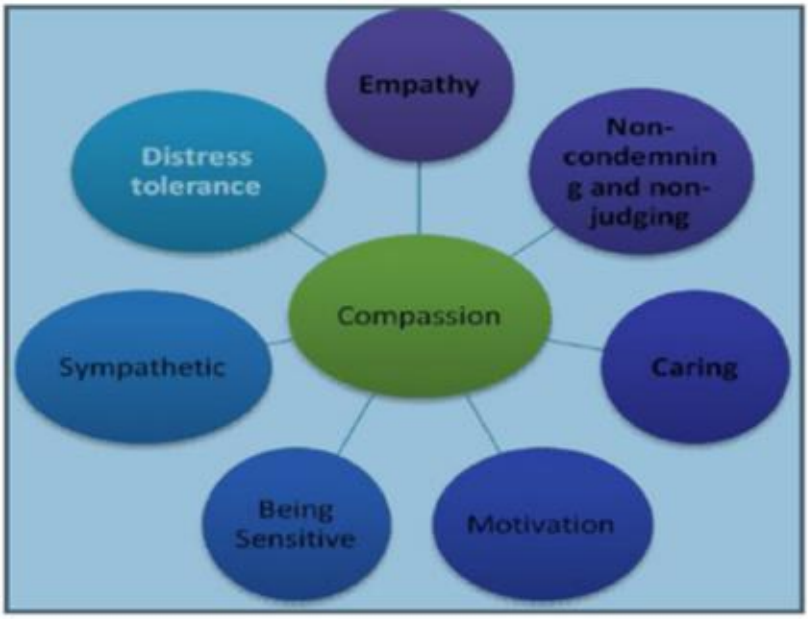
Compassion can be defined as: “sensitivity to the suffering of self and others with a deep wish and commitment to relieve the suffering”.

Developing more compassion can be a way to balance emotions to increase the well-being of patients, healthcare professionals and facilitation of healthcare delivery. For patients, compassion can help prevent health problems and speed-up recovery. Compassion can improve staff efficiency by enhancing cooperation between individuals and teams and between patient and healthcare professionals.

Individual reflection

- **Can compassion be trained and learned? Time Allowed: 5 Minutes**

Qualities of Compassionate Care



Role play on qualities of compassionate care:
Instructions:
One participant will take the role of a healthcare provider and another participant will take the role of a mother [with limited mobility] of a sick child with a feeding problem. Other participants should observe and note the discussion.

Roles
Healthcare provider
A mother (with limited mobility) of a sick child:

Situation:
A mother with limited mobility brings her 3-month-old baby girl with cough and fever to the outpatient clinic. The healthcare provider seemed tired. By the time the mother enters the examination room, he was talking with his subordinate about last night's football game. He had already noticed her but did not let her to sit. Her child was crying and she was trying to quiet her.
All of a sudden the healthcare provider shouted loudly at the mother to quiet her child or they would have to leave.

While waiting and calming her child, the mother told the healthcare provider that her child is very sick and needs an urgent care. While facing to his friend, the healthcare provider told the mother that he would see her child in five minutes.

After waiting for 10 minutes, the healthcare provider started to examine the child and felt sad about the condition of the child; apologized to her for having let her wait so long. The healthcare provider evaluated the child gently, gave the child a proper treatment, reassured the mother, and the child went home better.

Discussion Questions
Did the health provider demonstrate the characteristics of compassion?
If not, what are the areas /conversation that show poor characteristics of compassion?

If yes, what are the areas /conversation that show good characteristics of compassion?

Time allowed: 30 minutes

1.3.2. ELEMENTS OF COMPASSIONATE CARE

According to researches the key elements of compassionate care has categories, each contains theme and subthemes.

1. **Virtue:** It is described as ‘‘good or noble qualities embodied in the character of the health care provider
2. **Relational space:** is defined as the context and content of a compassionate encounter where the person suffering is aware of and is engaged by, the virtues of the health care provider.

THE CATEGORY OF RELATIONAL SPACE COMPRISED TWO THEMES.

- Patient awareness which describes the extent to which patients intuitively knew or initially sensed health care provider capacity for compassion.
- Engaged care giving which refers to tangible indicators of health care provider compassion in the clinical encounter that established and continued to define the health care provider-patient relationship over time.

3. Virtuous Response: It is the "Enactment of a virtue toward a person in suffering,'' and it is both an individual category and an overarching principle of care that functions as a catalyst to the three core categories of compassionate care giving: ''seeking to understand, relational communicating, and attending to needs'' The category of virtuous response contain three broad themes within it:

- Knowing the person refers to the extent to which healthcare providers approached their patients as persons and view their health issues and suffering from this point of view.
- Seeing the person as priority involves healthcare providers' ability to priorities patient needs, setting aside their own assumptions and healthcare system priorities in the process.
- Beneficence refers to healthcare providers wanting the best for the patient, informing the three more targeted core categories of compassionate care giving.

4. Seeking to Understand: refers to healthcare providers trying to know the patient as a person and his or her unique needs.

The need to understand a person's desires and tailor his or her care is identified by most patients as a fundamental feature of compassion.

- Seeking to Understand the Person.
- Seeking to Understand the needs of the Person

5. Relational Communication: is an important element of compassion identified by patients consisting of verbal and nonverbal displays conveyed by the healthcare provider's engagement with the person suffering.

There are four specific themes and associated subthemes that convey compassion within clinical communication:

- Demeanor (''being'')
- Affect (''feeling for'')
- Behaviors (''doing for'')
- Engagement (''being with'')

ATTENDING TO NEEDS

It refers to ‘‘a timely and receptive desire to actively engage in and address a person’s multi-factorial suffering’’. Attending to patients’ needs has three interrelated themes:

- Compassion-Related Needs: refers to the dimensions of suffering that patient feel compassion: physical, emotional, spiritual, familial and financial.
- Timely refers to addressing suffering in a ‘‘timely’’ manner.
- Action refers to the initiation and engagement of a dynamic and tangible process aimed at alleviating suffering. Compassion is more action.

1.3.3. PRINCIPLES OF COMPASSIONATE CARE

Individual reflection

❖ What are the principles of compassionate care?

Time Allowed: 5 Minutes

The universal principles of compassion will help us know one another in a more meaningful way where we discover one another respectfully. They create the conditions that allow a person who is suffering to experience the healing power of compassion.

1. **Attention:** is the focus of healthcare provider. Being aware will allow the healthcare provider to focus on what is wrong with a patient; or what matters most to the patient.
2. **Acknowledgement:** is the principle of what the healthcare professional says. The report of the examination or reflection on the patient’s message. Positive messages of acknowledgment are buoyant; they let someone know that you appreciate them as a unique individual.
3. **Affection:** is how healthcare providers affect or touch people. Human contact has the ability to touch someone’s life. It is the quality of your connection, mainly through warmth, comfort, kindness and humor. Affection brings joy and healing.
4. **Acceptance:** is the principle of being with mystery – how you stand at the edge of your understanding or at the beginning of a new experience, and regard what is beyond with equanimity. It is the quality of your presence in the face of the unknown, in the silence. Like the sun in the north at midnight, acceptance welcomes the mysteries of life and is at peace with whom we are and where we are, right now. It is the spirit of Shalom. The principle of acceptance is: being at peace with the way things are allows them to change.

1.3.4. THREATS TO COMPASSIONATE CARE

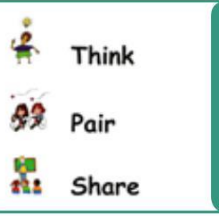
There are factors preventing compassion and compassionate behavior for individual members of staff, teams and units and health facility. Most research discusses compassion at the individual level. In general, the most common threats for compassionate care are:

- **Compassionate fatigue:** Physical, emotional and spiritual fatigue or exhaustion resulting from care giving that causes and a decline in the caregivers' ability to experience joy or feel and care for others.
  - ➢ A form of burnout, a kind of "secondary victimization" what is transmitted by clients or patients to care givers through empathetic listening.
- Unbalanced focus between biomedical model (clinical training) and person: Effective clinical care is clearly fundamentally important, but human aspects of medicine and care must also be valued in training and in terms of how to be a good healthcare professional.
- Stress, depression and burnout:
  - ➢ Self-reported stress of health service staff is reported greater than that of the general working population.
  - ➢ Burnout (or occupation burnout) is a psychological term referring to general exhaustion and lack of interest or motivation to work.
- Overall health facility context: Attention by senior managers and health facility boards to achieve financial balance that affects priorities and behaviors of staff in health facility.

ADDRESSING THREATS OF COMPASSION
• Overcoming compassion fatigue • Developing an inner compassionate self • Compassion to yourself • Teaching compassion to professionals through, training and education • Dealing with staff stress and burnout • Dealing with wider health facility context

1.4. RESPECTFUL CARE

1.4.1. DEFINITION OF CONCEPTS OF RESPECTFUL AND DIGNIFIED CARE



1. Can you share us your experience with regard to respect and dignity in the health care setting?
2. What does respectful care mean to you?
Time Allowed: 10 minutes

Definition of Dignity (ልእልና)

The word dignity originates from two Latin words: ‘dignitus’ which means merit and ‘dignus’ meaning worth. It is defined from two perspectives:

- Dignity is a quality of the way we treat others.
- Dignity is a quality of a person’s inner self.

Types of Dignity

There are four types of dignity: dignity of human being, personal identity, merit and moral status.

1. Dignity of human being

This type of dignity is based on the principle of humanity and the universal worth of human beings their inalienable rights-which can never be taken away.

2. Dignity of personal identity

This form of dignity is related to personal feelings of self-respect and personal identity, which also provides the basis for relationships with other people.

3. Dignity of merit

This is related to a person’s status in a society.

4. Dignity of moral status

This is a variation of dignity of merit, where some people have a personal status because of the way they perceived and respected by others. (N.B. Refer to Hand-out 3.1 for details.)

Attributes of Dignity

There are four attributes of dignity:

1. **Respect:** self-respect, respect for others, respect for people, confidentiality, self-belief and believe in others
2. **Autonomy:** having choice, giving choice, making decisions, competence, rights, needs, and independence
3. **Empowerment:** Feeling of being important and valuable, self-esteem, self-worth, modesty and pride
4. Communication (may be verbal or non-verbal): explaining and understanding information, feeling comfort, and giving time to the patients / families

Definition of Respect (አክብሮት)

- It is a term which is intimately related to dignity
- It is probably the most important action verb used to describe how dignity works in practice.

THE ACTION MEANINGS OF THE WORD RESPECT ARE:

- Pay attention to
- Honoring
- Avoiding damage e.g. insulting, injuring
- Not interfering with or interrupting
- Treating with consideration
- Not offending

People can vary by their skills, educational background, gender, age, ethnicity, and experiences. But, as human being, all are entitled to get dignified and respectful care. Every human being must respect others and get respect from others. Therefore, dignity is brought to life by respecting people:

- Rights and freedoms
- Capabilities and limits
- Personal space
- Privacy and modesty
- Culture
- Individuals believes of self-worth
- Personal merits
- Reputation
- Habits and values

DIGNITY AND RESPECT IN THE HEALTH CARE SETTING

Treating clients with dignity implies treating them with courtesy and kindness, but it also means:

- Respecting their rights
- Giving them freedom of choice
- Listening and taking into consideration what they say and

•Respecting their wishes and decisions, even if one disagrees.

Treating clients with dignity implies being sensitive to clients' needs and doing one's best for them, but it also means:

- Involving them in decision making
- Respecting their individuality
- Allowing them to do what they can for themselves and
- Giving them privacy and their own personal space

1.4.2. PRINCIPLES OF RESPECTFUL CARE

Individual reflection

❖ Think of a person who gave you the most respectful care/service.

• Describe the situation?

• What are the qualities of that person?

• What did you value most?

Time: 5 Minutes

The principles of respectful care guide actions and responsibility of care providers in ensuring dignified care for their service users. Dignified care has seven core principles.

- Recognize diversity and uniqueness of individuals
- Uphold responsibility to shape care
- Meaningful conversation
- Recognize the care environment
- Recognize factors affecting dignity
- Value workplace culture
- Challenge dignity barriers

1.4.3. CHARACTERISTICS OF DISRESPECTFUL CARE

The situation where you received disrespectful care?

1. Describe the incident?
2. What was your reaction?

Time: 5 Minutes

THE SEVEN CATEGORIES OF DISRESPECT AND ABUSE

Category	Example
Physical Abuse	Slapping, pinching, kicking, slapping, pushing, beating,
Non-consented care	Absence of informed consent or patient communication, forced Procedures
Non-confidential care	Lack of privacy (e.g. Laboring in public or disclosure of patient Information
Non-dignified care	Intentional humiliation, rough treatment shouting, blaming, treating to withhold services laughed at patients, provider did not introduce themselves, patients not called by their names Throughout the interaction.

Discrimination based on specific patient attributes	Discrimination based on ethnicity, age, language, economic status, education level, etc.
Abandonment of care	Women left alone during labor and birth Failure of providers to monitor patients and intervene when needed
Detention in facilities	Detention of patients/family in facility after delivery, usually due to failure to pay

1.4.4. FACTORS AFFECTING RESPECTFUL CARE PROVISION

Individual reflection

1. What do you think hinders you from providing respectful care in your health facility?
2. What are the factors that facilitates provision of respectful care in your health facilities?

Time: 5 Minutes

Different Factors have a significant impact on hindering or facilitating the provision of respectful care service. These factors can be broadly classified in to three major groups; Health care environment, staff attitude & behavior and patient factors

Positive attributes of the physical environment which helped health professional to provide dignified care are related to aspects maintaining physical and informational privacy and dignity, aesthetically pleasing surroundings and single sex accommodation, toilet and washing facilities. Aspect of the environment that maintain physical and informational privacy are listed below

- Environmental privacy (for example curtains, doors, screens and adequate separate rooms for intimate procedures or confidential discussions (auditory privacy).
- Privacy of the body: covering body, minimizing time exposed, privacy during undressing and clothing are some of the enabling factors to ensure bodily privacy done by health professionals.
- Aesthetic aspects of the physical environment (for example space, color, furnishing, décor, managing smells); and the provision of accommodation, toilet and washing facilities
- Managing peoples in the environment: such as other patients, family and ward visitors/public contribute positively to maintain dignity in the health
- Adequate mix and proficient Staffing: adequately staffed with appropriate number and skill mix, as high workload affects staff interactions, and have strong leaders who are committed to patient dignity.

Physical environment which hinders health professional form providing respectful care are related to the overall health care system, lack of privacy, restricted access to facility /service and lack of resources. Aspect of the environment that hinders the provision of respectful care are listed below,

- The healthcare System: Shortage of staff, unrealistic expectations, poorly educated staff, ‘quick fix’ attitude, low wage, pay ‘lip service’ to dignity, low motivation, lack of respect among professionals, normalization/tolerance of disrespectful care, lack of role model, management bureaucracy and unbalanced staff patient ratio and skill mix.

- Lack of privacy: Lack of available single rooms, bath rooms and toilets without nonfunctional locks, use of single rooms only for infectious cases and lack of curtains or screens
- Restricted access to facility/service: Badly designed rooms, inadequate facilities (e.g. toilets, bath rooms), Cupboards with drawers that does not open, toilet and bath rooms shared between male and females.
- Lack of resource: Run out of hospital, gowns and pyjamas, Lack of medical equipment and supplies The A, B, C, of respectful health care, is a tool designed to consider the attitudes and behaviors of health care providers

A –ATTITUDE

Ask yourself:

- How would I be feeling if I was this person?
- Why do I think and feel this way?
- Are my attitudes affecting the care I provide and, if so, how?
- Are my personal beliefs, values, and life experiences influencing my attitude?

ACTION TO BE TAKEN

- Reflect on these questions as part of your everyday practice.
- Discuss provider attitudes and assumptions and how they can influence the care of patients with the care team.
- Challenge and question your attitudes and assumptions as they might affect patient care
- Help to create a culture that questions if and

B- BEHAVIOR

- Introduce yourself. Take time to put the patient at ease and appreciate their circumstances.
- Be completely present. Always include respect and kindness.
- Use language the patient/family can understand

C-COMMUNICATION

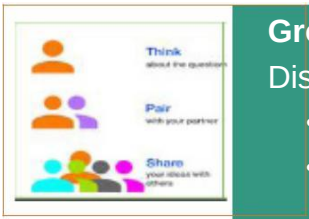
- Communication revolving around the patient's needs.
- Patient centered communication with defined boundaries

TEN MECHANISMS TO MITIGATE THREATS TO RESPECTFUL CARE -

1. Support clients with same respect you would want for yourself or a member of your family
2. Have a zero tolerance of all forms of disrespect
3. Respect clients' right to privacy
4. Maintain the maximum possible level of independence, choice, and control
5. Treat each client as an individual by offering personalized care
6. Assist clients to maintain confidence and a positive self esteem
7. Act to alleviate clients' loneliness and isolation
8. Listen and support clients to express their needs and wants
9. Ensure client feel able to complain without fear of retribution
10. Engage with family members and care givers as care partners?

1.5. COMPASSIONATE LEADER

1.5.1. QUALITY OF COMPASSIONATE LEADERSHIP



Group exercise

Discuss in a group of 4-5 and share your experience to the larger group.

- What does it mean for you to lead, and manage?
- Can you give an example of a leader whom you know in your professional or personal life? What makes him or her good leader for you?
- Do you know of any individuals in high positions or authority who demonstrate compassionate, respectful and caring practices when they deal with their staff and clients?

Duration: 20 minutes

BRIEF DESCRIPTION OF LEADERSHIP THEORIES

Introduces transactional, transformational, and servant leadership theories. It will also provide a better understanding of qualities of CRC leaders, which will enable participants to provide better service and increase awareness of CRC leadership.

- **Transformational leaders:** lead employees by aligning employee goals with their goals. Thus, employees working for transformational leaders start focusing on the company's well-being rather than on what is best for them as individual employees.
- **Transactional leaders:** ensure that employees demonstrate the right behaviors because the leader provides resources in exchange.
- **Servant Leadership:** defines the leader's role as serving the needs of others. According to this approach, the primary mission of the leader is to develop employees and help them reach their goals. Servant leaders put their employees first, understand their personal needs and desires empower them and help them develop their careers.

CHARACTERISTICS OF COMPASSIONATE LEADERS

- 'In-tune' feeling: Their actions abide by their words – and they always have the time to engage with others.
- Manage their moods: They know feelings affect others and they use positive emotions to inspire, not infect others with negative feelings.
- Put people before procedures: They are willing to set aside or change rules and regulations for the greater good.

- Show sincere, heartfelt consideration: They genuinely care for the well-being of others and have a humane side that puts other people's needs before theirs.
- Are mindful: They are aware of their own feelings and their impact on others. They are also attentive and sympathetic to the needs of others.
- Are hopeful: They move others passionately and purposefully with a shared vision that focuses on positive feeling of hope.
- Courage to say what they feel: They communicate their feelings, fears, even doubts which builds trust with their employees.
- Engage others in frank, open dialogue: They speak honestly with humility, respect and conviction, and make it safe for others to do the same.
- Connective and receptive: They seem to know what other people are thinking and feeling.
- Take positive and affirming action: They carry out compassion. They do not just talk about it; they make a promise, act on it and keep it.

WHAT DOES COMPASSIONATE LEADERSHIP DO FOR THE ORGANIZATION?

- Positively affects sufferers, clients, employees
- Increases people's capacity for empathy and compassion
- Promotes positive relationships
- Decreases the prevalence of toxic viral negative emotions and behavior
- Increases optimism and hope
- Builds resilience and energy levels
- Counteracts the negative effects of judgment and bias

SELF-EVALUATION OF COMPASSIONATE BEHAVIOR

Good leaders can evaluate their own behavior using different methodologies. The self-assessment of compassionate leaders should be conducted every six months to enhance self-compassion through mindfulness.

Mindfulness begins with self-awareness: knowing yourself enables you to make choices how you respond to people and situations. Deeper knowledge about yourself enables you to be consistent, to present yourself authentically. You will learn and practice different ways to develop mindfulness and explore how it can contribute to developing compassionate leadership practices through:

- Enhancing attention and concentration
- Increasing creativity and flexibility
- Working efficiently in complex systems and uncertain environments

- Creating meaning and purpose
- Making effective and balanced decisions
- Responding effectively to difference and conflict
- Acting with compassion and kindness
- Enhancing relationships and partnerships
- Enabling genuine and courageous action
- Working ethically and wisely
- Developing cultural intelligence

1.5.2. SYSTEMS THINKING FOR CRC

Group activity in healthcare system thinking

Discuss in a group of 4-5 and share your experience to the larger group.

- Discuss concepts of Health System and how it relates with your Health Facility /Hospital and Health Center/ functions.
- Take your Health Facility/Hospital and Health Center/ and list the various department/core processes/support processes. Using a systems thinking approach, discuss how they interact with each other?
- Take in to account the CRC concepts and identify gaps you may have experienced in your facilities?

Duration: 20 minutes

System: A system is a set of interacting or interdependent components forming an integrated whole.

Health System: A health system consists of all the organizations, institutions, resources and people whose primary purpose is to improve health.

Fully functional health system: A point which various management systems and subsystems are connected and integrated to provide the best possible health services to all the intended beneficiaries of those services.

Management systems: The various components of the overall health system that managers use to plan organize and keep track of resources. Management systems are run by people living in different contexts.

INTEGRATE CRC INTO EXISTING SYSTEM

Integration of new initiatives into existing system has paramount importance in expediting the process of implementation and ensuring sustainability of CRC in a health system. Integration can be done using “AIDED” model.

Assess: Understand the capacity of the unit structure, especially in regards to the availability of resources, as well as human resource; also to assess the level of human capability when integrating and sustaining the CRC by determining the level of support the unit requires before or after carrying out CRC.

Innovate: Design and package the CRC to fit with the existing quality of unit structure and their environmental context to spread the CRC throughout the hospital departments.

Develop: Build upon existing knowledge of main stakeholders and opinion leaders by encouraging hospital policies, organizational culture, and infrastructure to support the implementation of principles of CRC.

Engage: Use existing roles and resources within the hospital units to introduce, translate, and integrate CRC principles into each employee's routine practices.

Devolve: Capitalize on existing organizational network of index user groups to release and spread the innovation to new user groups.

1.5.3. ORGANIZATIONAL CULTURE

Organizational culture consists of the values and assumptions shared within an organization. Organizational culture directs everyone in the organization toward the "right way" to do things. It frames and shapes the decisions and actions of managers and other employees. As this definition points out, organizational culture consists of two main components: shared values and assumptions.

1. Shared Values: are conscious perceptions about what is good or bad, right or wrong. Values tell us what we "ought" to do. They serve as a moral guidance that directs our motivation and potentially our decisions and actions.

2. Assumptions: are unconscious perceptions or beliefs that have worked so well in the past that they are considered the correct way to think and act toward problems and opportunities.

Five key systems influence the hospital's effective performance with respect to improving the safety and quality of patient care, as well as sustaining these improvements. The systems are:

1. Using data
2. Planning
3. Communicating
4. Changing performance
5. Staffing

LEADERS CREATE AND MAINTAIN A CULTURE OF SAFETY AND QUALITY THROUGHOUT THE HOSPITAL. RATIONALE

- CRC thrives in an environment that supports teamwork and respect for other people, regardless of their position in the organization.
- Leaders demonstrate their commitment to CRC and set expectations for those who work in the organization. Leaders evaluate the culture on a regular basis.
- Leaders encourage teamwork and create structures, processes, and programs that allow this positive culture to flourish. Disruptive behavior that intimidates others and affects morale or staff turnover can be harmful to patient care.
- Leaders must address disruptive behavior of individuals working at all levels of the organization, including management, clinical and administrative staff, licensed independent practitioners, and governing body members.

CREATING AN ORGANIZATIONAL CULTURE OF EMPOWERING EMPLOYEES FOR CRC

Having empowered employees is the aim of many leaders. Literature has reported that creating an organizational culture will empower employees to increase customer satisfaction levels, as well as to improve employee morale and productivity.

Employee empowerment encourages communication, participation in shared decision-making and enabling physicians and staff to reach their full potential by creating and optimal healing environment.

There are many different ways to build employee empowerment and engagement, but all share six fundamental actions to promote CRC on the part of leadership:

Share information and communication: Sharing information with employees is important because it not only helps to build trust; it gives employees important information to allow them to make the best possible decisions in critical situations when providing CRC services.

Create clear goals and objectives: Inspire employees to embrace the mission or changes of the organization by appealing to their innate desire to help patients and provide an efficient CRC service. Great leaders share important information in a structured and consistent manner.

Teach, accept and encourage: If you empower employees to make decisions that will help keep customers happy, then you have to be willing to allow them to make mistakes and learn from those mistakes.

Reward Self-Improvement: Create an environment that celebrates both successes and failures. A good leader celebrates successes; and employees who take risks for the benefits of patients/client; also, a good leader will assist employees to develop a plan for growth and reward them as they advance.

Support a learning environment: Listen to the voice of physicians, nurses and other staff to understand key barriers, issues, and opportunities to allow them to have a voice in crafting solutions for CRC challenges.

Create a clear role of autonomy: Enable frontline workers to execute change by supplying resources (education, funding, access to other skill sets within the health facility, etc.) and removing obstacles themselves.

1.5.4. LEADING CRC HEALTH TEAMS

Group activity

Discuss in a group of 4-5 and share your experience to the larger group.

- What principles do you think of when implementing CRC?
- Do you think there are differences between your current "leading" style and leading based on CRC? If yes, list the differences.

Duration: 10 minutes

Health facility leaders have intersecting roles as public servants, providers of health care, and managers of both healthcare professionals and other staff.

- As public servants, health facility leaders are specifically responsible for maintaining the public trust, placing duty above self-interest and managing resources responsibly
- As healthcare providers, health facility leaders have a fiduciary obligation to meet the healthcare needs of individual patients in the context of an equitable, safe, effective, accessible and compassionate health care delivery system.
- As managers, leaders are responsible for creating a workplace culture based on integrity, accountability, fairness and respect.

ETHICAL HEALTHCARE LEADERS APPLY AT LEAST THE FOLLOWING SIX SPECIFIC BEHAVIORAL TRAITS:

1. **Ethically conscious**: Have an appreciation for the ethical dimensions and implications of one's daily actions and decisions or, as described by author John Worthily, the "ethics of the ordinary" (reference?).
2. **Ethically committed:** Be completely devoted to doing the right thing.
3. **Ethically competent:** Demonstrate what Rush worth M. Kidder, president and founder of the Institute for Global Ethics, calls "ethical fitness," or having the knowledge and understanding required to make ethically sound decisions (reference).

4. **Ethically courageous:** Act upon these competencies even when the action may not be accepted with enthusiasm or endorsement.
5. **Ethically consistent:** Establish and maintain a high ethical standard without making or rationalizing inconvenient exceptions. This means being able to resist pressures to accommodate and justify change inaction or a decision that is ethically flawed.
6. **Ethically candid:** Be open and forthright about the complexity of reconciling conflicting values; be willing to ask uncomfortable questions and be an active, not a passive, advocate of ethical analysis and ethical conduct.

PROBLEM-SOLVING IN HEALTHCARE

Steps of Scientific Problem Solving Skills

1. Define the problem
2. Set the overall objective
3. Conduct a root cause analysis
4. Generate alternative interventions
5. Perform comparative analysis of alternatives
6. Select the best intervention
7. Develop implementation plan and implement plan
8. Develop evaluation plan and evaluate

BEST PRACTICE IDENTIFICATION

Criteria to select best practices

- **New/Novel idea-** not much practiced in other hospitals in Ethiopia
- **Effectiveness:** has brought empirical change to the implementation of CRC specifically to patient satisfaction and quality of service provision. The practice must work and achieve results that are measurable.
- **Relevant/impact:** improved CRC and quality of patient experience (Explain the relevance of the innovation using a clear baseline and current performance of CRC)
- **Diffusible:** implemented at low cost in other facilities or implemented innovation in other hospitals.
- **Sustainable:** Innovation is easy to understand, easy to communicate and works for long time.
- **Political commitment:** The proposed practice must have support from the relevant national or local authorities.

The practice must respect the current rules of ethics for dealing with human populations.

By definition, “Best Practices” should be “new/novel”, “effectiveness” and “relevance”.

MONITORING AND EVALUATION OF CRC HEALTH TEAM

Potential focus areas where leaders focus to evaluate their CRC staff

- **Quality of work:** Provide accuracy and thorough CRC service
- **Communication and interpersonal skills:** listening, persuasion and empathy to clients/patients and teamwork and cooperation in implementing CRC
- **Planning, administration and organization:** setting objectives, and prioritizing CRC practice
- **CRC knowledge:** knowledge-based training, mentoring, modeling and coaching
- **Attitude:** dedication, loyalty, reliability, flexibility, initiative, and energy towards implementing CRC
- **Ethics:** diversity, sustainability, honesty, integrity, fairness and professionalism
- **Creative thinking:** innovation, receptiveness, problem solving and originality
- **Self-development and growth:** learning, education, advancement, skill-building and career planning

1.6 SUMMARY

- Dignity of human being is the basis for healthcare delivery
- Clients should be treated as human being not as cases
- Disrespect and abuse is a problem in Ethiopia.
- Zero Tolerance to Disrespectful care shall be a motto for all health workers in the health facilities.
- Improving the knowledge of ethics is important to boost the ethical behavior in practice

Chapter 2:
Slit Lamp

CHAPTER DESCRIPTION:

This chapter describes about slit lamp to have an overview for the trainer to develop their knowledge, Skill and attitude on slit Lamp maintenance. This material is prepared with both Instruction manual and checklist of activities for both the trainee and trainer. It is a training material which anticipating questions in the mind of the trainee about what he/she can do next, why it is important and where it can be found on their perspective health facilities. Also, this material will provide directions on the care and maintenance of electrical parts, optical parts, aligning optics and the necessary safety precaution for Slit Lamp.

PRIMARY OBJECTIVE:

At the end of this session, the participants will be able to:

- • Maintain slit lamp.

SPECIFIC OBJECTIVES:

At the end of this chapter the participants will be able to:

- Explain the Purpose of Slit Lamp
- Describe working principle of Slit Lamp
- Explain clinical applications of Slit Lamp
- Identify the main components of Slit Lamp and their functions
- Explain the main components of Slit Lamp and their functions
- Prepare the required tools, Instruments and materials for maintaining Slit Lamp
- Perform preventive maintenance procedure for Slit Lamp
- Perform Troubleshooting for Slit Lamp
- Perform corrective maintenance for Slit Lamp according to the manufacturers instruction
- Follow the safety procedure of Slit Lamp according to manufacturer's specifications.

CHAPTER OUTLINE

- 2.1. Introduction to Slit Lamp
- 2.2. Working principle Slit Lamp
- 2.3. Main components of Slit Lamp and their functions
- 2.4. General Considerations for Maintaining Slit Lamp
- 2.5. Preventive maintenance procedure of Slit Lamp
- 2.6. Troubleshooting Slit Lamp
- 2.7. Safety of Slit Lamp
- 2.8. Summary

2.1. INTRODUCTION TO SLIT LAMP

Group activity
1. What do you know about Ophthalmology…?

2. List some Ophthalmic

Equipment's… Time: 5 Minutes

Today the slit lamp is the ophthalmologist's most frequently used and most universally applicable examination instrument. The most important field of application is the examination of the anterior segment of the eye including the crystalline lens and the anterior vitreous body. Supplementary optics such as contact lenses and additional lenses permit observation of the posterior segments and the iridous corneal angle that are not visible in the direct optical path.

A number of accessories have been developed for slit lamps extending their range of application from pure observation to measurement, such as for measuring the intraocular pressure. The documentation of findings on electronic media is increasingly gaining importance as it provides a convenient medium for keeping track of a disease's progress. The use of the slit lamp in contact lens fitting is an important recent application worth mentioning. The modern instrument has increasingly gained applications beyond the traditional ophthalmologist´s practice.

The purpose of this Training guide is to provide the necessary knowledge and skill to enable Biomedical Engineer/ Technician to maintain the Slit lamp with the required level of performance.

2.2. WORKING PRINCIPLE OF SLIT LAMP

The illumination system is intended to produce a slit image that is as bright as possible, at a defined distance from the instrument with its length, width, and position being variable. Today this is achieved using optical imaging with the so-called Köhler illumination.

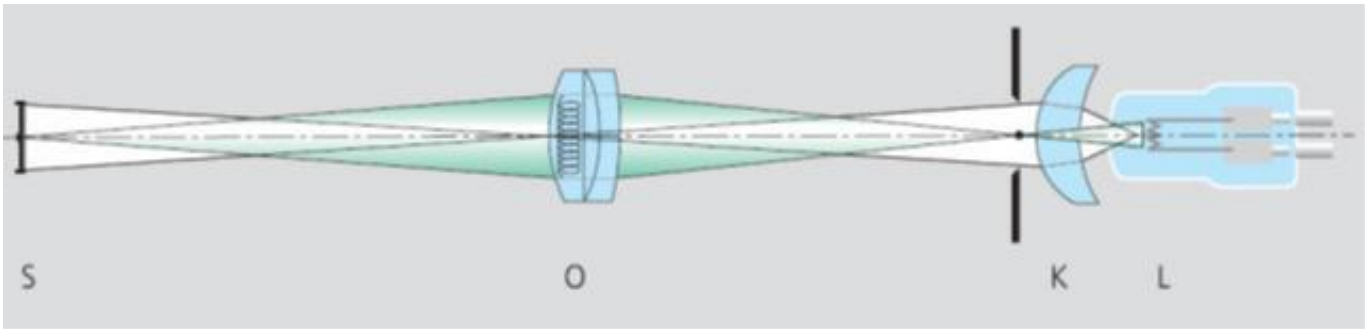


Figure 2 Principle of K'ohlr illumination
(Source, Prof. Allvar Gullstrand Nobel Prize Winner in Physiology and Medicine 05.06.1862 – 28.07.1930)

(Fig.2). the light source L is imaged in the objective O by the collector system K. The objective in turn produces an image at S in the mechanical slit located next to the collector system. The image of the light source at O is the exit pupil of the system. Köhler illumination provides a very homogeneous slit image even with a structured light source. This is an advantage over illumination systems imaging the light source in the slit and projecting the latter into the eye together with the image of the light source. The brightness of the slit image is characterized by the illuminance of the slit image which depends on the luminance of the light source, the transmission of imaging optics, the size of the exit pupil, and the distance between exit pupil and slit.

2.3. MAIN COMPONENTS OF SLIT LAMP AND THEIR FUNCTIONS

The standard slit lamp is comprised of three main components:

- Slit illumination (Light) system
- Stereomicroscope
- Mechanical(Patient Head- Rest) system

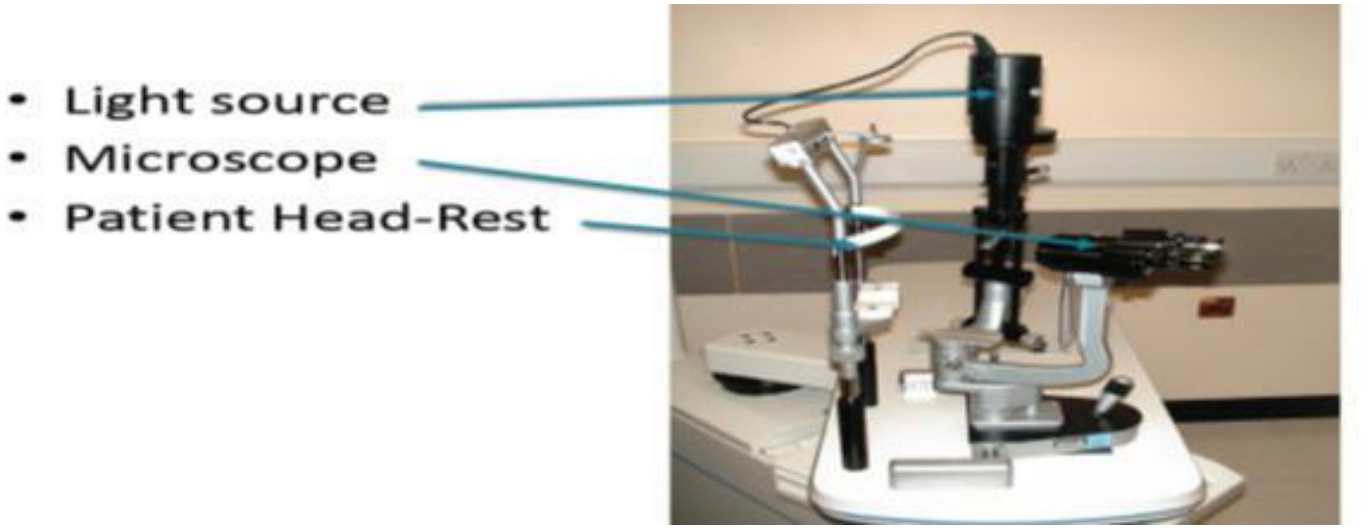


Figure 3.System of standard Slit Lamp (Source, from Prof. Jennifer P. Craig) **SLIT ILLUMINATION SYSTEM**

The slit lamp is an instrument consisting of a high-intensity light source that can be focused to shine a thin sheet of light into the eye. It is used in conjunction with a bio-microscope. The lamp facilitates an examination of the anterior segment, or frontal structures and posterior segment, of the human eye, which includes the eyelid, sclera, conjunctiva, iris, natural crystalline lens, and cornea. The binocular slit-lamp examination provides stereoscopic magnified view of the eye structures in detail, enabling anatomical diagnoses to be made for a variety of eye conditions. The light source used on a slit lamp is either a low voltage incandescent lamp or a halogen lamp. The latter being preferred because of its high luminance and color temperature. The brightness of the slit image is characterized by the luminance of the slit image which depends on the luminance of the light source, the transmission of imaging optics, the size of the exit pupil, and the distance between exit pupil and slit.

Figure 4. Slit lamp examination of the eyes in an ophthalmology clinic (Source:http://en.wikipedia.org/w/index.php?title=File:Slit_lamp_Eye_examination_by_Ophthalmologist.jpg)

STEREOMICROSCOPE

The slit lamp microscope is used to provide optimum stereoscopic observation with selectable magnification. The size of the field of view and the depth of field are expected to be as large as possible, and there should be enough space in front of the microscope for manipulation on the eye.

MECHANICAL SYSTEM

The illumination system can align to the stereomicroscope by means of the mechanical support. The illumination system and the microscope can both be swung about a common vertical axis independent of each other. The visual axis is a virtual extension of the mechanical instrument axis, the rotational point being located below the patient's eye. See the main components of the slit lamp on Fig. 2.

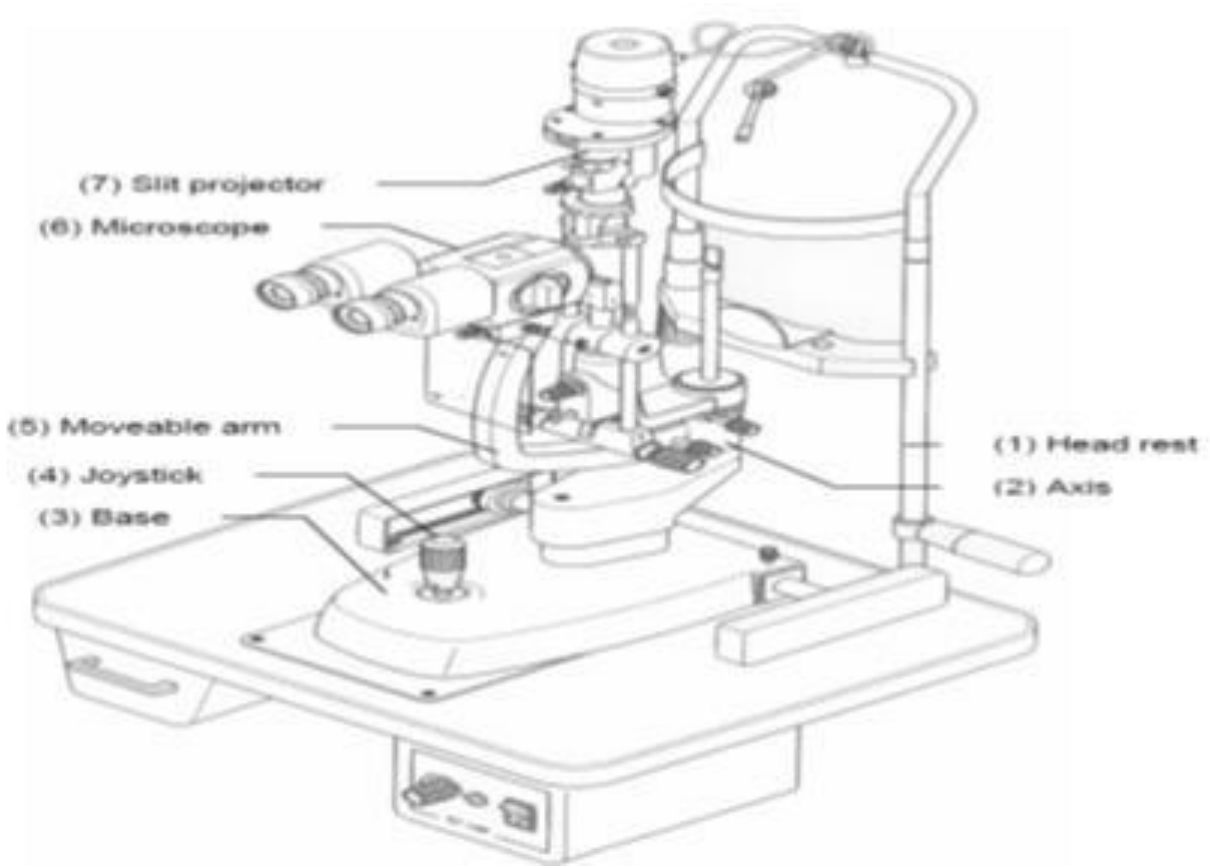


Figure 5.Main components of Slit lamp

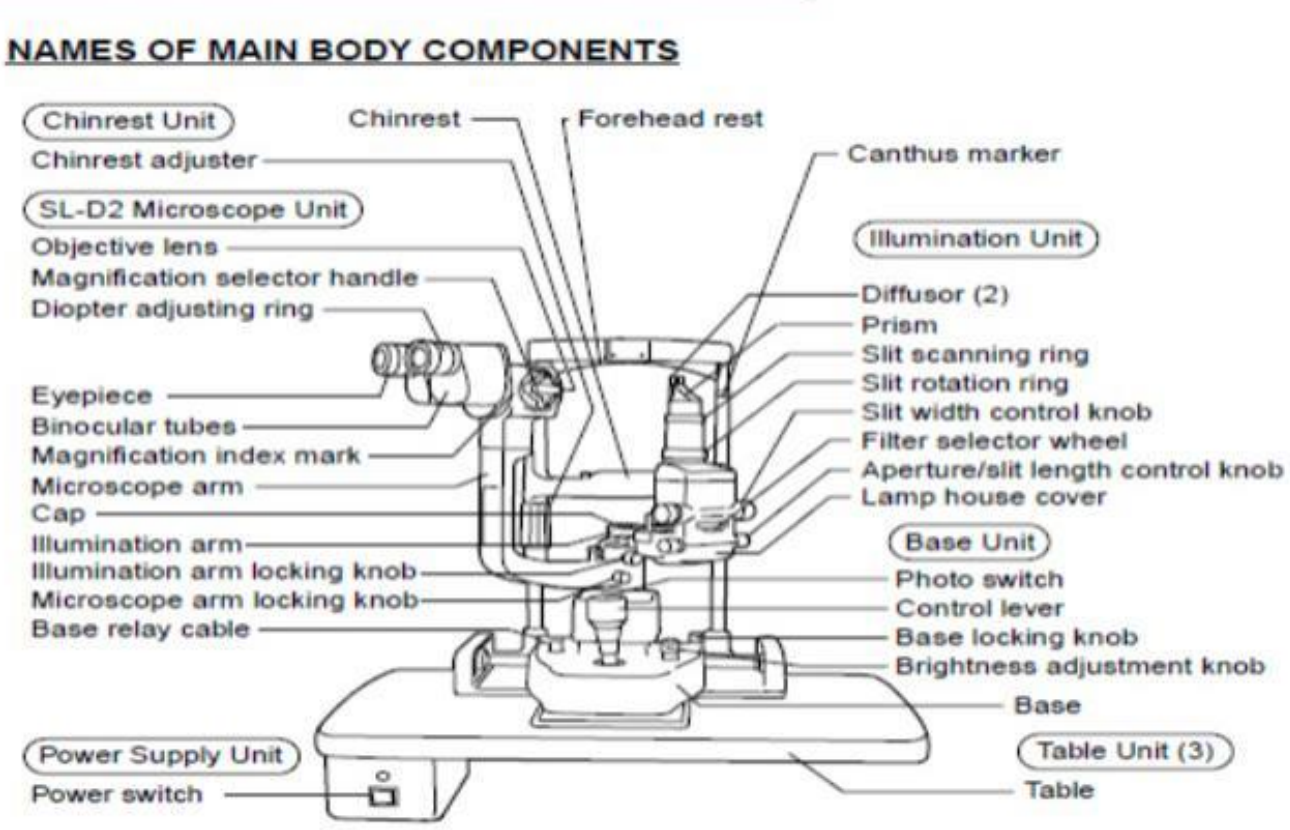


Figure 6.Main components of Slit lamp

PART DESCRIPTIONS

The slit lamp sits on a base (3) with orthogonal movement. The slit lamp can be moved in an x and y direction using the joystick (4). Moving the joystick from left to right will change the height (approx. 4cm) of both the microscope (6) and the slit projector (7) to line up with the eye to be examined. The microscope and slit projector can be moved independently on the joint axis (2).

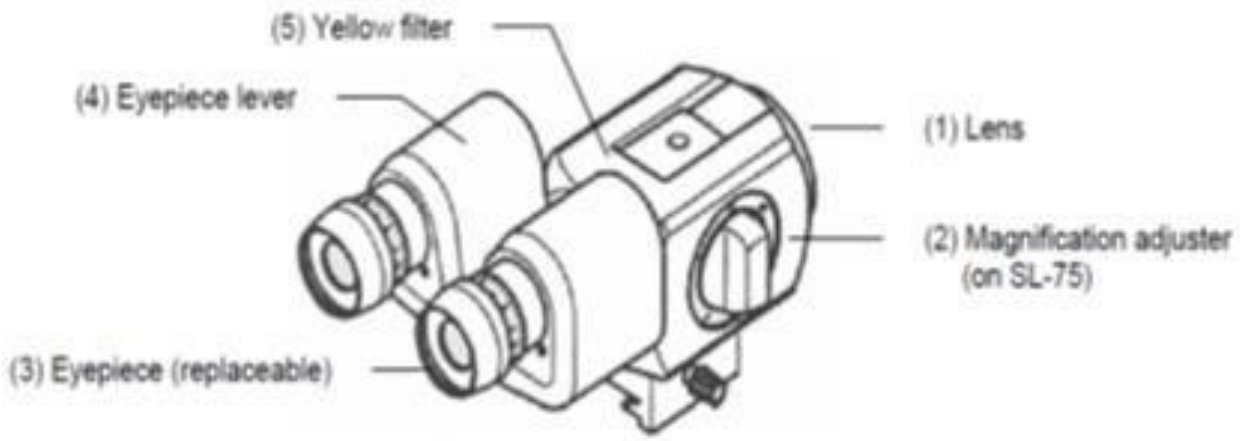


Figure 7.Microscope of the slit lamp

The eyepiece (3) with standard 12.5x magnification enables an ametropic equalization of +/- 5 dpt. By extending or pushing in the eyepiece lever (4), the distance to the pupil can be adjusted. Magnification adjuster (2): 6x/10x/16x/25x/40xdepending on the model of the Slit Lamp.

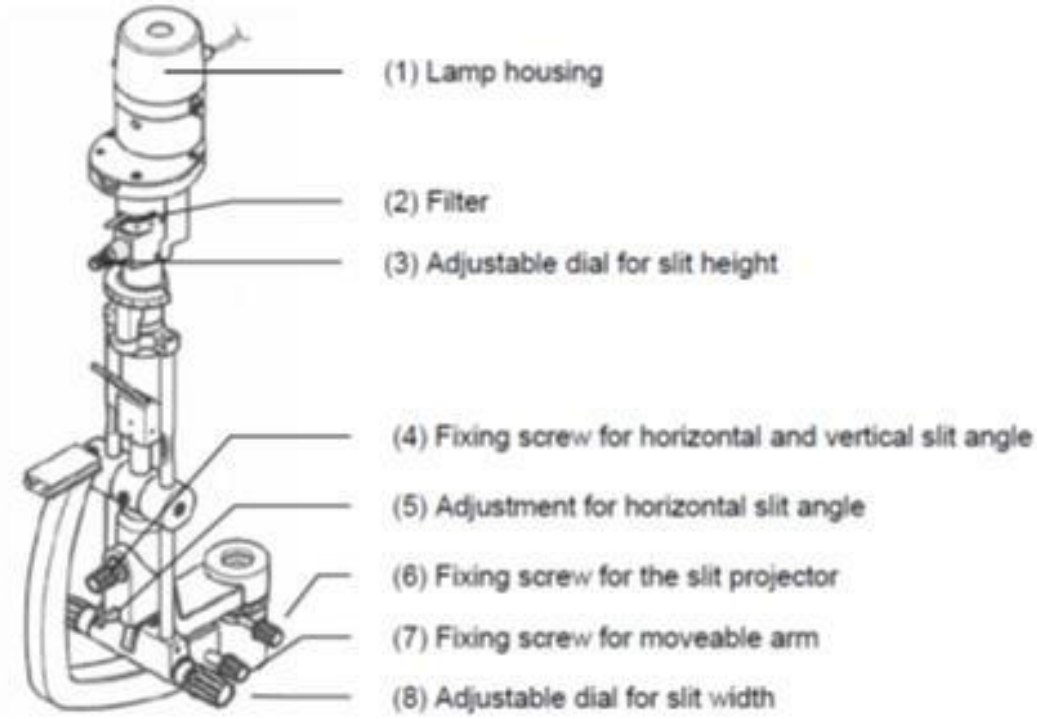


Figure 8 Slit projectors

As shown on fig. 4, the slit projector offers a wide spectrum of different types of lighting. Depending on the model, the slit width (8) can be continuously adjusted from 0 to 14mm. The slit height (3) can be continuously varied from 1.8 to 12mm with the optional use of apertures and a blue filter. Green, blue, red and grey (heat protection) filters are also available as filters (2).
By loosening the fixing screw (4), the slit projector can be inclined horizontally at four different levels (5) and turned vertically.

2.4. GENERAL CONSIDERATIONS FOR MAINTAINING OPHTHALMIC EQUIPMENT'S

: Individual reflection

1. What is troubleshooting?

2. Discuss about troubleshooting steps?

3. Discuss the main steps to maintain medical equipment…? Time: 5 Minutes

Most ophthalmic diagnostic devices have optical components such as lenses, mirrors, and prisms. Many of these components have a special thin coating for filtering specific wavelengths of light, for reflecting light, or for reducing reflection. Great care must be exercised in handling and operating ophthalmic equipment. Conceder followings:

- Dust and stains become harder to clean when they accumulate and therefore periodic cleaning is recommended. However, excessive cleaning can lead to quick deterioration of the surface coating. Specific manufacturer instructions for frequency and method of cleaning should be followed for

each device. All ophthalmic equipment should be kept under dust covers when not in use.

- In regions with hot and humid climates, it is very common for fungus to grow on optical components such as lenses and mirrors. In its first stages, fungus would not be perceivable by the clinician.
  With time the fungus covers the lens surface in a web like manner. Initially there will be a very slight loss of image brightness, followed by decreased contrast due to light reflecting off the fungus. In its final stages, the fungus etches the outer coatings of the lens and image sharpness deteriorates. Removing fungus from lenses is extremely difficult and rarely yields good results. Ultraviolet radiation (sunlight or an ultraviolet lamp) or paraldehyde may be used to kill fungus. Once killed, the fungus may be easier to remove but the outer coatings of the lens will most likely have irreversible damage.
- Optics should be kept in a dry place with plenty of air circulation to prevent fungus growth. Air conditioners and dehumidifiers are very helpful in preventing fungus growth but if not available, the optics can be kept in a sealed container with packets of desiccant such as silica gel.
- Bulbs are common in most ophthalmic devices. When replacing bulbs, care should be taken to not touch them with bare fingers. Oils from the skin create hot spots on the bulb that can shorten the bulb's life. Additionally, fingerprints can become etched into the bulb's glass jacket and cause a shadow on the illumination field.
- Any maintenance that involves precise alignment of optics, or calibration of potentially dangerous forms of energy such as laser energy, should only be performed by manufacturer representatives or by qualified factory-trained personnel.
- Lens cleaning solution, if lens cleaning solution is not commercially available, a water-based mild detergent solution can be utilized.

2.5. PREVENTIVE MAINTENANCE PROCEDURE OF SLIT LAMP

Group activity

• Discuss about the purpose and role of Preventive maintenance for Slit Lamp.
Time: 5 Minutes

The level of serviceability of Slit Lamp in the hospital depends on the equipment design, the technology used, the level of support provided by the manufacturer, the available tools and test equipment, and the skills and training of the institution's biomedical equipment personnel. In order to maintain the Slit Lamp the technician should be able to:

- Understand the correct handling and use of Slit Lamp
- Understand the possible defects of Slit Lamp
- Perform preventive maintenance procedure such as,
  - ✓ Cleaning parts
  - ✓ Replacement of spares
  - ✓ Care of electrical parts.
  - ✓ Care of optical parts.
  - ✓ Aligning optic

2.6. TROUBLESHOOTING CHART FOR SLIT LAMP

Problem	Possible cause	Check
Illumination lamp does not work	Cable connection is Disconnected	Check cable connection.
	Base relay cable is switched off.	Connect the cable.
	Plug of lamp house cover is switched off	Insert plug.
	POWER switch is OFF	Turn ON POWER switch.
	Brightness adjustment knob is the minimum	Turn up brightness adjustment knob.
	Illumination lamp is broken	Replace it with a new illumination lamp
	Socket has deteriorated	Replace it with a new socket
Illumination field is not uniform/ isshady/is dark	Filter selector lever is out of Position	Click filter selector lever
Fixation target lamp does not Work	Fixation cable is off	Insert cable
Fuse blows	Rated capacity of fuse is Incorrect	Use fuse with correct rating & authorized fuse.
	Over Voltage from the system	Check the power source
	Internal short circuit	Check internal circuit
The slit tilts.	Slit-disk is wrongly set at a point away from the red dot.	Set the slit-disk and spot-disk at the reddot.
Part of the illumination light or slit is obscured	Slit-disk or spot-disk is wrongly set at appoint away from the red dot.	Set the slit-disk at the red dot.
Out of focus.	Diopter is wrongly set at a point away from a desired value.	Adjust to a desired diopter.
Slit light is too dim	The bulb is not correctly inserted.	Insert bulb correctly
	Filter lever is at ND position, or at an intermediate position.	Set the filter lever (28) to the correct position
	Voltage selector setting is incorrect.	Check voltage selector and set itto the correction position.
Slit width closes by Itself	Tension on the slit width control knob is too weak	Tighten the slit width control knob (20) to adjust the tension
Fixation bulb does not light	The connecting cable between power source and chin-rest is not correct	Insert the power cable firmly in Outlet.
	The fixation target bulb has burned-out	Replace the fixation target bulb

2.7. SAFETY PRECAUTIONS

- Do not subject the slit lamp to extremes of temperature. It is recommended that the device be used at temperatures of between +10° C and +40° C.
- The slit lamp must not be used in areas where there is a danger of explosion.
- Avoid dropping or splashing water on the device.
- The slit lamp must only be used by authorized persons.
- Do not attempt to move or shake the slit lamp with excessive force. First check whether the adjustment screws have been loosened.
- The moveable arm and slit projector can move up and down between their bases. Make sure you don't squash your hands.
- Do not open the protective cover of the halogen lamp whilst the device is in use. You could be burnt

2.8. CHAPTER SUMMARY

- Most ophthalmic diagnostic devices have optical components such as lenses, mirrors, and prisms. Many of these components have a special thin coating for filtering specific wavelengths of light, for reflecting light or for reducing reflection.
- The slit lamp is an instrument consisting of a high-intensity light source that can be focused to shine a thin sheet of light into the eye. It is used in conjunction with a bio-microscope. The lamp facilitates an examination of the anterior segment, or frontal structures and posterior segment, of the human eye, which includes the eyelid, sclera, conjunctiva, iris, natural crystalline lens, and cornea.
- The illumination system is intended to produce a slit image that is as bright as possible, at a defined distance from the instrument with its length, width, and position being variable.

Chapter 3:
Application of Tonometer

CHAPTER DESCRIPTION:

This chapter describes about Tonometer to have an overview for the trainer to develop their knowledge, Skill and attitude on Tonometer maintenance. This material is prepared with both Instruction manual and checklist of activities for both the trainee and trainer. It is a training material which anticipating questions in the mind of the trainee about what he/she can do next, why it is important and where it can be found on their perspective health facilities. Also, this material will provide procedures on the care and maintenance of electrical parts, optical parts, aligning optics and the necessary safety precaution for Tonometer.

PRIMARY OBJECTIVE:

At the end of this session, the participants will be able to maintain Tonometer.

ENABLING OBJECTIVES:

At the end of this chapter, participants will be able to:

- Explain the purpose of Tonometer.
- Describe working principle of Tonometer.
- Identify the main components of Tonometer and their functions.
- Explain the main components of Tonometer and their functions.
- Discuss on general considerations for maintaining Tonometer.
- Perform preventive maintenance procedure for Tonometer.
- Perform Troubleshooting for Tonometer.
- Follow the safety procedure of Tonometer according to manufacturer's specifications.

CHAPTER OUTLINE

- 3.1.Introduction to Tonometer
- 3.2. Working principle Tonometer
- 3.3. Main components of Tonometer and their functions
- 3.4. General Considerations for Maintaining Tonometer
- 3.5. Preventive maintenance procedure of Tonometer
- 3.6. Troubleshooting Tonometer
- 3.7. Safety for Tonometer
- 3.8. Summary

3.1. INTRODUCTION TO TONOMETER

Group activity

1. **What is intraocular pressure of the eye?**
2. **What are Tonometer and its application? Time: 5 Minutes**

In music, a Tonometer is an instrument used to determine the pitch or vibration rate of tones, such as a tuning fork. In ophthalmology, Tonometry is the procedure eye care professionals perform to determine the intraocular pressure (IOP), the fluid pressure inside the eye. It is an important test in the evaluation of patients with glaucoma. In medicine, a Tonometer is an instrument for measuring tension or pressure of the eye. The Application of Tonometer is a complex assembly of numerous components interacting with each other. Each component involved must interact with the others with great accuracy. Mostly the components are operated in combination with a slit lamp.

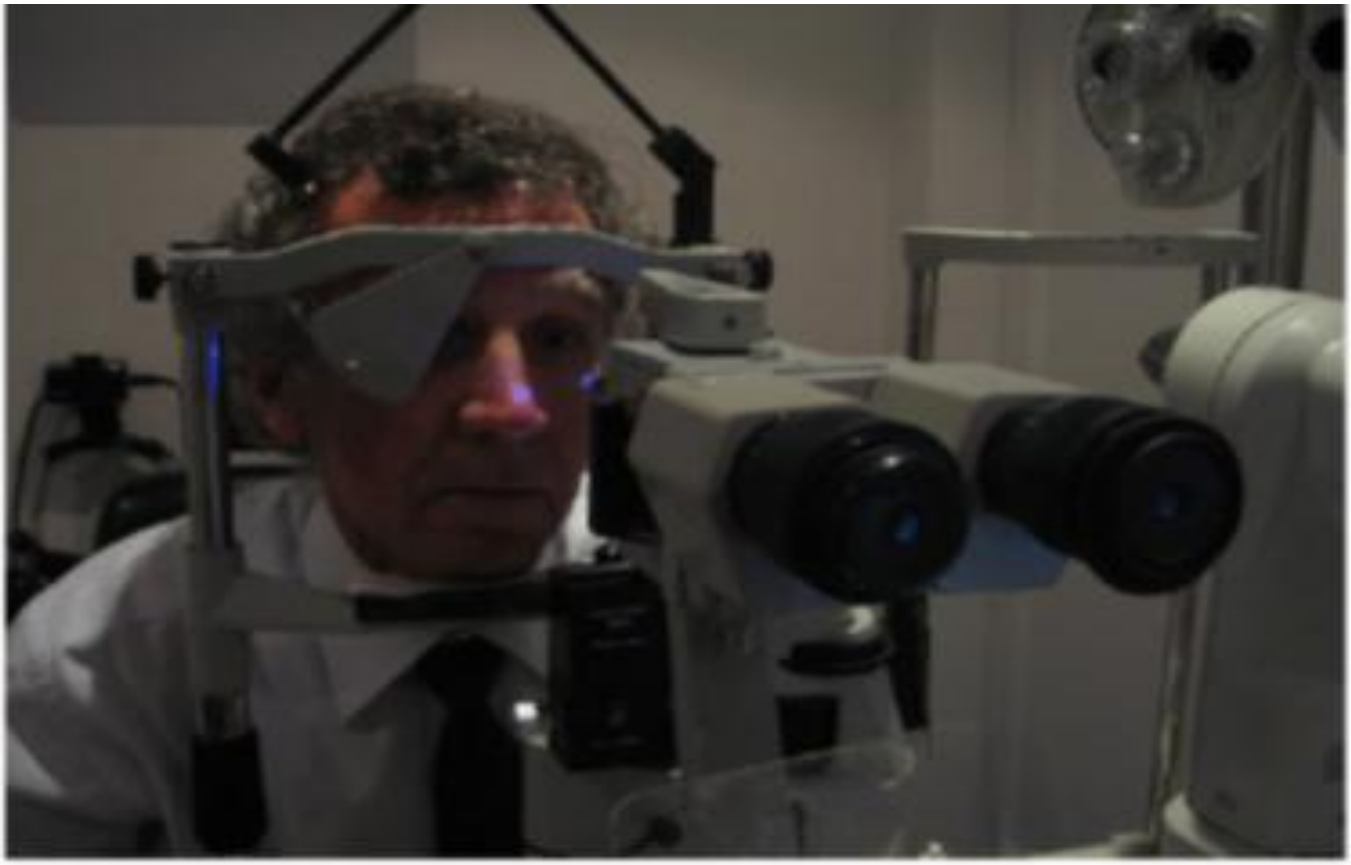


Figure 9. A patient in front of a Tonometer (Source: from Tonometry procedure handout)

3.2. WORKING PRINCIPLE OF APPLICATION TONOMETER

The Applanation Tonometer defines the intraocular pressure, by measuring the force required to flatten a defined surface of the cornea. The cornea is applanated by a Plexiglas pressure-corpus, which is set in a ring-shaped retainer at the end of the pressure arm. The circular pressure surface has a diameter of 7,0 mm and is flat, featuring a rounded edge, whereby an injury of the cornea is made impossible. The pressure corpus is brought into contact with the patient's eye by mowing the slit lamp forward. Then the pressure corpus is pushed onto the eye with increasing force, until an area with a diameter of 3.06 mm (this equals a circular area of 7.35 mm2) is flattened. The user accomplishes the precise optical

measurement of the small flattening surface visually, by using a factor 10 magnification on the slit lamp. In the area of surface contact between cornea and pressure corpus the tear fluid is forced outward. It contains fluorescence and shines green-yellow because of the blue light. The boundary between flattened and curved cornea appears clearly as a fine green-yellow band. The built-in doubling system within the pressure corpus splits the picture of the flattened circle and displaces the two halves by 3, 06 mm to each other. The rigidity of the cornea and the eye-ball (bulbous) is inconsiderable, due to the fact that the small area of flattening, of only 7,35mm², the shift in volume only amounts to a mere 0, 56 mm³. The intraocular pressure is only raised by approximately 2.5% through the measuring process. Repeated measurements do not decrease the intraocular pressure, because a massage-effect does not occur due to the low pressure increase. The measured data is displayed directly in mmHg. All versions have high accuracy. The error of a single measurement averages at approximately ± 0.5 mmHg.

3.3. PARTS OF THE APPLANATION TONOMETER

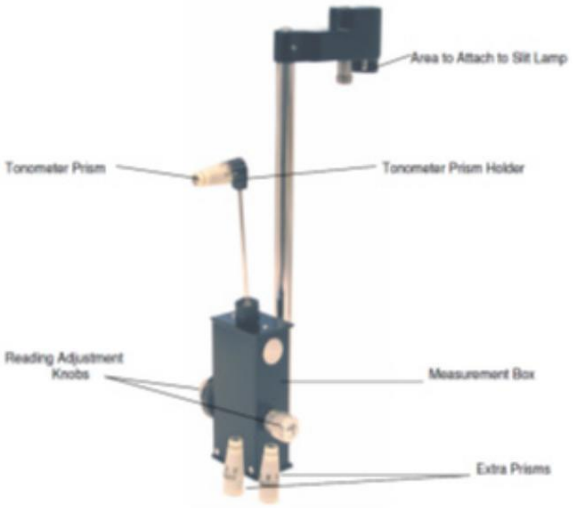


Figure 10 Applanation (Non-contact) Tonometer

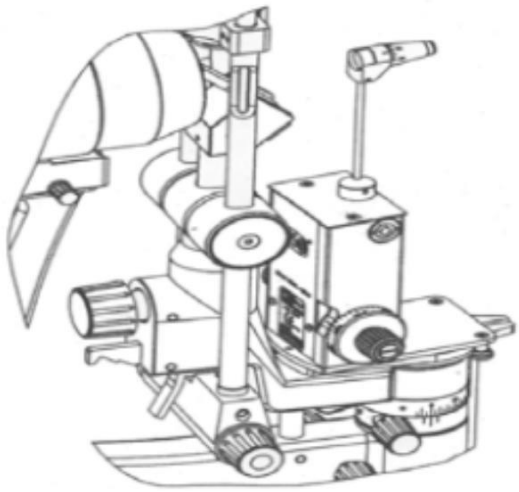


Figure 11. Applanation Tonometer mounted on Slit Lamp

As shown on fig. 10, the main parts of Applanation Tonometer are;

1. Tonometer Prism
2. Reading adjustment Knobs
3. Measurement Box
4. Tonometer prism Holder
5. Area to attach Slit Lamp

3.4. DISASSEMBLY AND ANALYSIS OF PARTS

When removing components from the assembly it is essential to check whether components are dysfunctional. It is essential that all components are not bent or damaged in any way as this could lead to an inability to calibrate once assembled. It is essential to ensure that the mounting arm (for the R-Type) and the mounting plate (for the T-Type) are not damaged in any way. A damaged mounting feature will make a calibrated unit invalid once mounted.

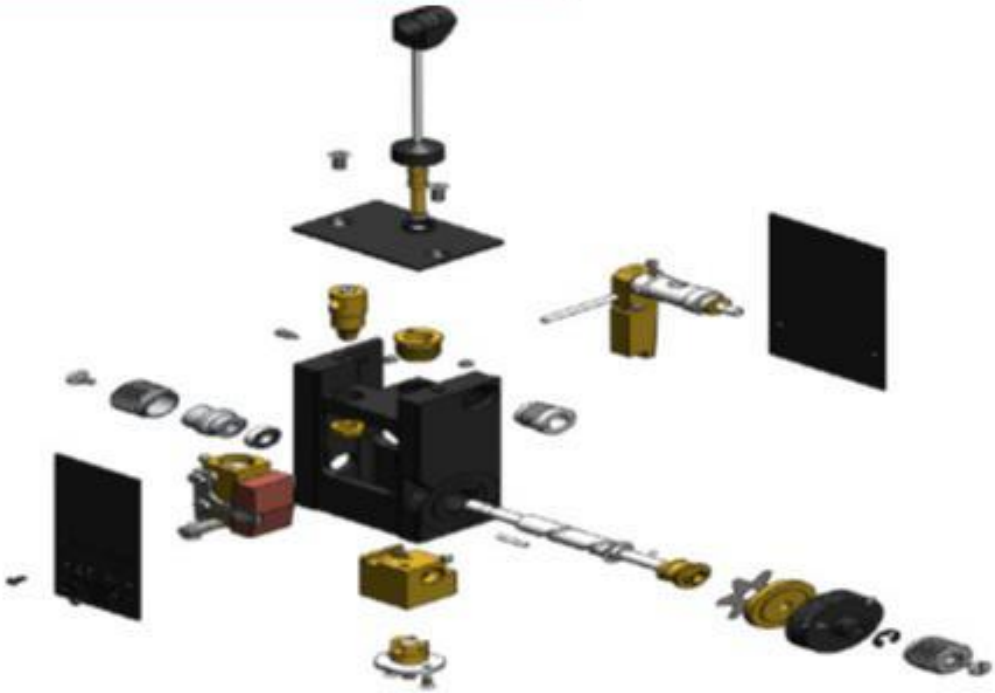


Figure 12. Dismantled view of the full assembly of Applination Tonometer (Source:keelerapplanation tonometer service manual)

Pivot Swing Arm

1. Loosen the grub screw at the front of the pivot assembly as shown in Figure 5.

Figure 13 Grub Screw Removal

2. Remove the arm assembly as shown in Figure 6 and confirm that it is not damaged in any way. Replace any damaged parts.

NOTE: Check the bearing has sufficient rotation as a slow bearing will cause inefficiencies within the system

• If required to the whole arm assembly can be replaced. This can occur in assemblies that have been dropped and badly damaged. Where possible please re-use components. Figure 7 shows the components of the prism arm assembly (the pivot collar contains a spring and a ball bearing but if collar is replaced please replace also)

Figure 15 Prism Arm Assembly

DIAL ASSEMBLY

Rotate the knurled knobs around in both directions to check the smoothness of the motion. This is shown in. Check the lead screw to see if it feels bent. Also, check for any movements that are not smooth. If the motion is not smooth then the assembly requires dismantling and assessing. Figure 8 shows the assembled view of the dial system.

Figure 16 Assembled view of the dial system

NOTE: Check the bearing that is removed to ensure that it has adequate freedom of rotation.

3.5. GENERAL CONSIDERATIONS FOR MAINTAINING TONOMETER

- Make sure that the applanation tonometer is properly mounted to the slot lamp.
- The measuring prism must be disinfected.
- Keep it clean and dry.
- Avoid high temperatures.

3.6. PREVENTIVE MAINTENANCE PROCEDURES

Group activity

•Discuss about the main steps of Preventive maintenance for tonometer

Time: 5 Minutes

The activities under preventive maintenance for Applanation Tonometer, involve routine cleaning, calibrating, adjusting and checking for wear and tear and lubricating the moving parts. The main reason for servicing Tonometer is to re-calibrate a system that has become out of calibration. Therefore, the first operation of the servicing will be to check the calibration. Once the calibration error is diagnosed it is necessary to directly locate the problem and fix by whatever means are required to complete. The calibration process is a very precise operation and requires very small and detailed alterations to the balancing of the entire system. Ensure all the details of the calibration are completed. In Tonometer there are two key parts of the assembly that usually require attention depending on the diagnosis of issues. These are:

PROTECTING THE INSTRUMENT ASSEMBLY

- The instrument should be used in a clean environment.
- Clean the Applanation Tonometer only with water dampened cloth, use soap only.
- Calibrate according to manufacturer's instruction

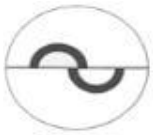
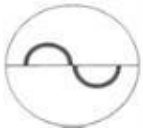
PROTECTING THE TONOMETER PRISM

- Only clean the prism with 3% hydrogen peroxide.
- Clean the gauging prism under running cold water.
- Disinfect the gauging prism in accordance to the instruction manual of the disinfectant.
- Dry the gauging prism with a clean and soft cloth.
- Store the gauging prism in a clean and dry container

3.7. CORRECTIVE MAINTENANCE

The corrective maintenance procedures for application Tonometer is mostly go with correcting the alignment error on complex assembly of numerous components interacting with each other Such as, gauging prism.

3.8. TROUBLESHOOTING CART FOR TONOMETER

PROBLEM	POSSIBLE CAUSE	SOLUTION
Fluoresceine band too wide 	The gauging prism was not dried properly after cleaning, or the eyelid came in contact with the gauging prism during the measurement.	Abort the measurement and dry-off the gauging prism
Fluoresceine band too narrow 	The tear fluid dried out during the longer measurement	Abort the measurement and let the patient close his eyes a few times in order to produce tear liquid.
Fluoresceine band too big 	The gauging prism is not touching the cornea correctly.	Retract the slit lamp and re-apply the gauging prism until you can observe an even pulsation.
	b) The protection weight is squeezing the eye. The flattened area is too big.	
The two semi-circular surfaces are not positioned in the middle of the pupil Area 	The position of the gauging prism is not correct.	Lift the slit lamp and move it to the left
The inner edges of the fluorescein bands do not touch each other 	The measuring pressure is too Low.	Increase the pressure with the Measuring drum.
The inner edges of the fluorescein bands do not touch each other 	The measuring pressure is too High	Decrease the pressure with the Measuring drum.

3.9. SAFETY FOR TONOMETR

- Do not use alcoholic solutions for disinfections
- Do not use the instrument under flammable, explosive, or dusty environments.
- Avoid high temperatures.
- Do not disassemble the instrument.
- Do not immerse Tonometer in solution, or corrosive agents.
- Do not attempt to move or shake the slit lamp with excessive force. First check whether the adjustment screws have been loosened.

3.10. CHAPTER SUMMARY

- Tonometry is the procedure eye care professionals perform to determine the intraocular pressure (IOP), the fluid pressure inside the eye. It is an important test in the evaluation of patients with glaucoma. The Application of Tonometer is a complex assembly of numerous components interacting with each other.
- The Applanation Tonometer defines the intraocular pressure, by measuring the force required to flatten a defined surface of the cornea. The cornea is applanated by a Plexiglas pressure-corpus, which is set in a ring-shaped retainer at the end of the pressure arm.
- Applanation Tonometer, involve routine cleaning, calibrating, adjusting and checking for wear and tear and lubricating the moving parts.

Chapter 4:
Operating Microscope

DESCRIPTION:

This chapter describes about operating microscope to have an overview for the trainer to develop their knowledge, Skill and attitude on operating microscope maintenance. This material is prepared with both Instruction manual and checklist of activities for both the trainee and trainer. It is a training material which anticipating questions in the mind of the trainee about what he/she can do next, why it is important and where it can be found on their perspective health facilities. Also, this material will provide directions on the care and maintenance of electrical parts, optical parts, aligning optics and safety procedures for operating microscope.

PRIMARY OBJECTIVE:

At the end of this session, the participants will be able to maintain Operating Microscope.

- Maintain fetal monitor based on the acquired knowledge, skill and attitude.

ENABLING OBJECTIVES:

At the end of this chapter the participant will be able to:

- Explain the purpose of Operating Microscope
- Describe working principle of Operating Microscope
- Identify the main components of Operating Microscope and their functions
- Explain the main components of Operating Microscope and their functions
- Discuss on general considerations for maintaining Operating Microscope
- Perform preventive maintenance procedure for Operating Microscope
- Perform Troubleshooting for Operating Microscope
- Follow the safety procedure of Operating Microscope according to manufacturer's specifications.

CHAPTER OUTLINE

4.1 Introduction to Operating Microscope
4.2. Working principle Operating Microscope
4.3. Main components of Operating Microscope and their functions
4.4. General Considerations for Maintaining Operating Microscope
4.5. Preventive maintenance procedure of Operating Microscope
4.6. Troubleshooting Operating Microscope
4.7. Safety of Operating Microscope
4.8. Summary

4.1. INTRODUCTION TO OPERATING MICROSCOPE

Group activity:

1. What is Operating Microscope …

2. List the different types of Operating Microscope… Time: 5 Minutes

An operating or surgical microscope is an optical instrument that provides the surgeon with a stereoscopic, high quality magnified and illuminated image of the small structures in the surgical area.

Ophthalmologists and other eye care professionals use many devices to diagnose and treat eye problems. The human eye functions basically the same as a camera. A basic surgical microscope is an optical instrument, mechanical, electrical or both, consisting of a combination of lenses which provide the surgeon with a stereoscopic, high quality magnified and illuminated image of small structures with the surgical area. A key characteristic of any surgical microscope is its design. In order for the surgeon to concentrate on the surgical procedure, the microscope is designed such that the surgeon remains comfortable and free of eye strain.

Eye surgeons use operating microscopes for procedures that require high magnification and variable focusing. The operating microscope has features such as pedal-controlled motorized focusing, motorize zoom magnification, and motorized lateral and longitudinal (x-y) positioning. These allow the surgeon to concentrate on the surgery rather than on manipulating

A set of articulated arms connects the microscope head assembly to a mobile floor stand, wall mount, or ceiling mount. The lens system consists of eyepiece lenses, magnification lenses, and objective lenses. The magnification of operating microscope eyepieces is typically 8X to 20X. Objective lenses are described by their working distance or focal length which is the focused distance from the objective lens to the viewed object. The typical focal length of objective lenses for eye surgery using 12.5X eyepiece is 75 to 200 mm.

Ophthalmic operating microscopes are designed to provide high contrast and detailed imaging of all regions of the human eye and also are suitable for the examination and surgery in the dentistry, ENT and ophthalmology.

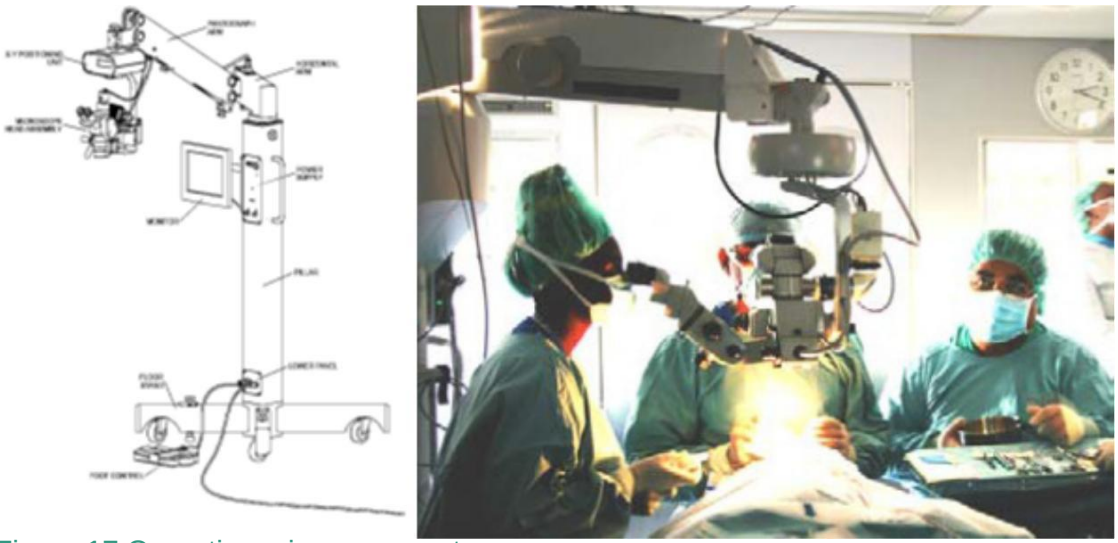


Figure 17 Operation microscope set

4.2. WORKING PRINCIPLE OF OPERATING / SURGICAL MICROSCOPE

Group activity:

• Discuss the working principles for Operating microscop

Time: 5 Minutes

Light from a halogen lamp is directed into the tube through prisms or fiber optic cables and shines through the objective lens onto the operating field. The light beam is reflected from the operating field through the objective lens and the magnification changer drum to the eyepieces. The surgeon then sees the image of the operating field. The surgical microscope is a complicated system of lenses that allows stereoscopic vision at a magnification of approximately 4-40X with an excellent illumination of the working area. The light beams fall parallel onto the retinas of the observer so that no eye convergence is necessary and the demand on the lateral rectus muscles is minimal.

OPTICAL COMPONENTS OF SURGICAL MICROSCOPE

The optical components of a basic stereo microscope consist of the binocular head, a magnification changer, the objective lens and an illuminator which beams light through the objective lens and onto the operating field (Figures). The binocular head consists of two telescopes with adjustable eyepieces for users with refractive error. The magnification can be changed by turning a knob (which selects different magnification lenses) or by using a motorized zoom controlled by a foot pedal. The working distance (Figure) is the distance from the microscope objective lens to the point of focus of the optical system. This value is fixed and is dependent on the chosen focal length of the objective lens. The choice of working distance depends on the type of surgery. For modern ophthalmic surgery that involves delicate work in the posterior chamber, objective focal lengths of 150 mm, 175 mm and 200 mm are commonly used.

The optical system often includes a beam splitter and a second set of teaching binoculars (Figure) so that two people can view the operation simultaneously. The optical system is attached to the suspension arm of the floor stand (Figure). The suspension arm makes it possible to position the optics exactly and to fix them in place. The floor stand has wheels and can be moved around the floor and fixed into place using the brakes. A foot pedal connected to the floor stand allows the surgeon to control the focus, the zoom, the position of the optics over the eye (the x,y position on the horizontal plane) and to turn the illumination on and off.

The illumination system is usually housed in the floor stand in order to keep the bulb heat away from the operating field. In this case, the light is transmitted to the operating field by means of a fiber optic cable. The light in ophthalmic micro scopes is usually coaxial, meaning that it follows the same path as the image in order to avoid shadows.

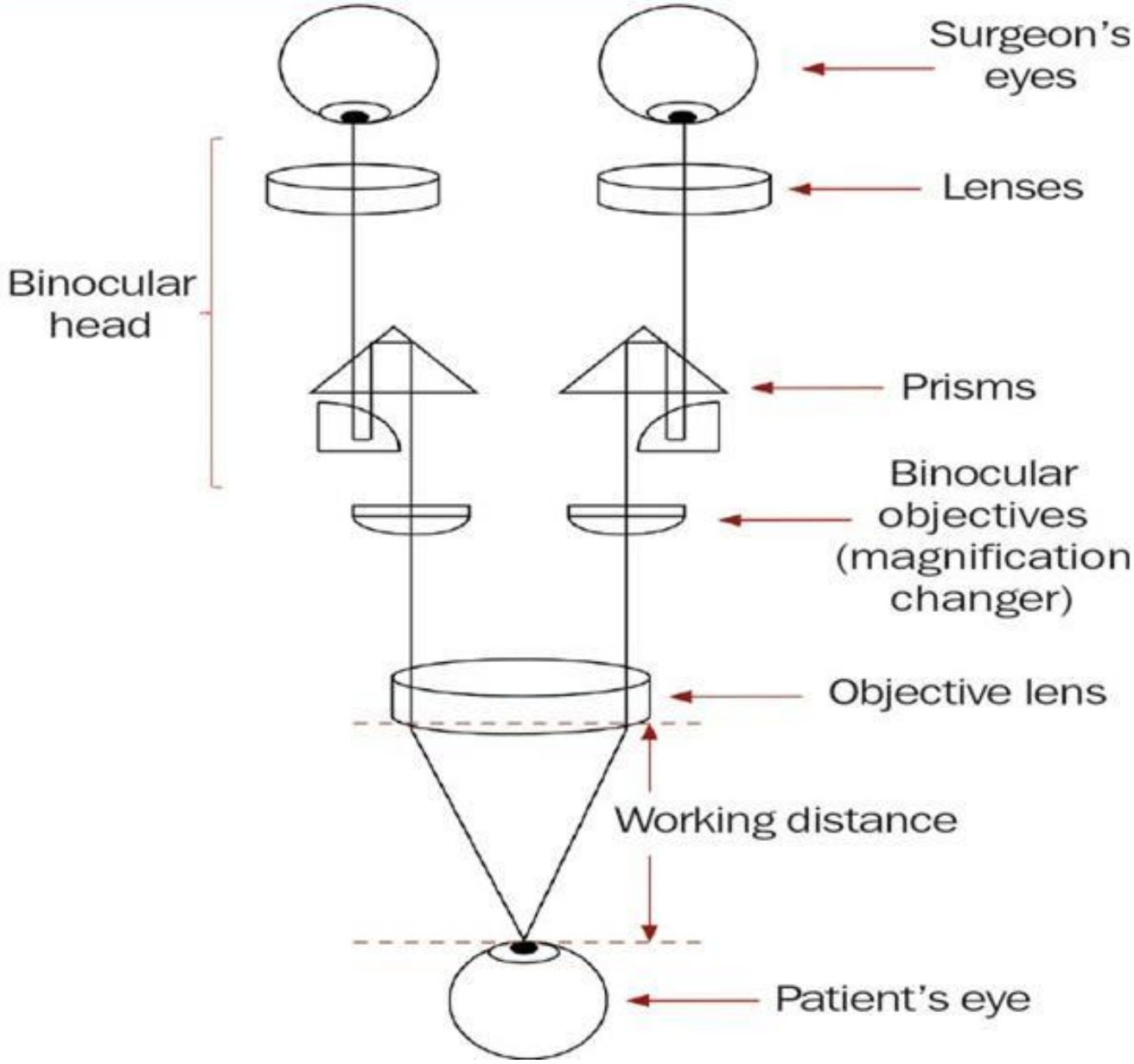


Figure 18 Optical diagram

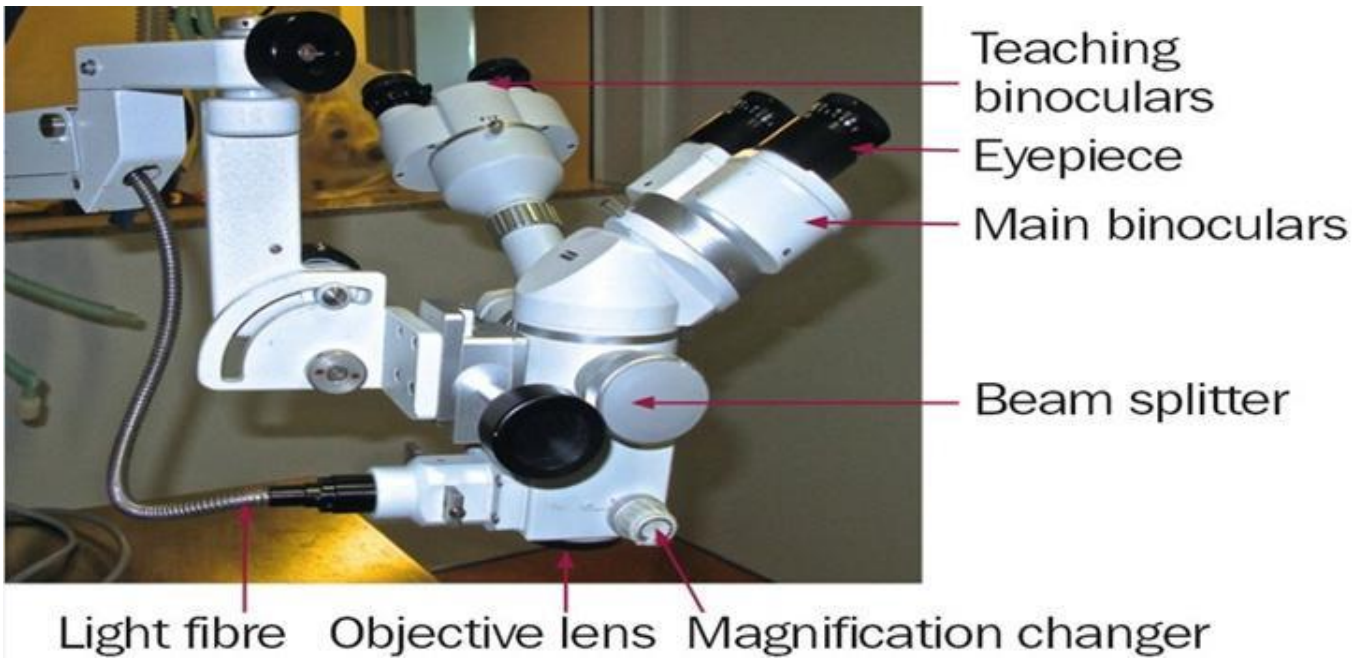


Figure 19 teaching type Operating Microscope

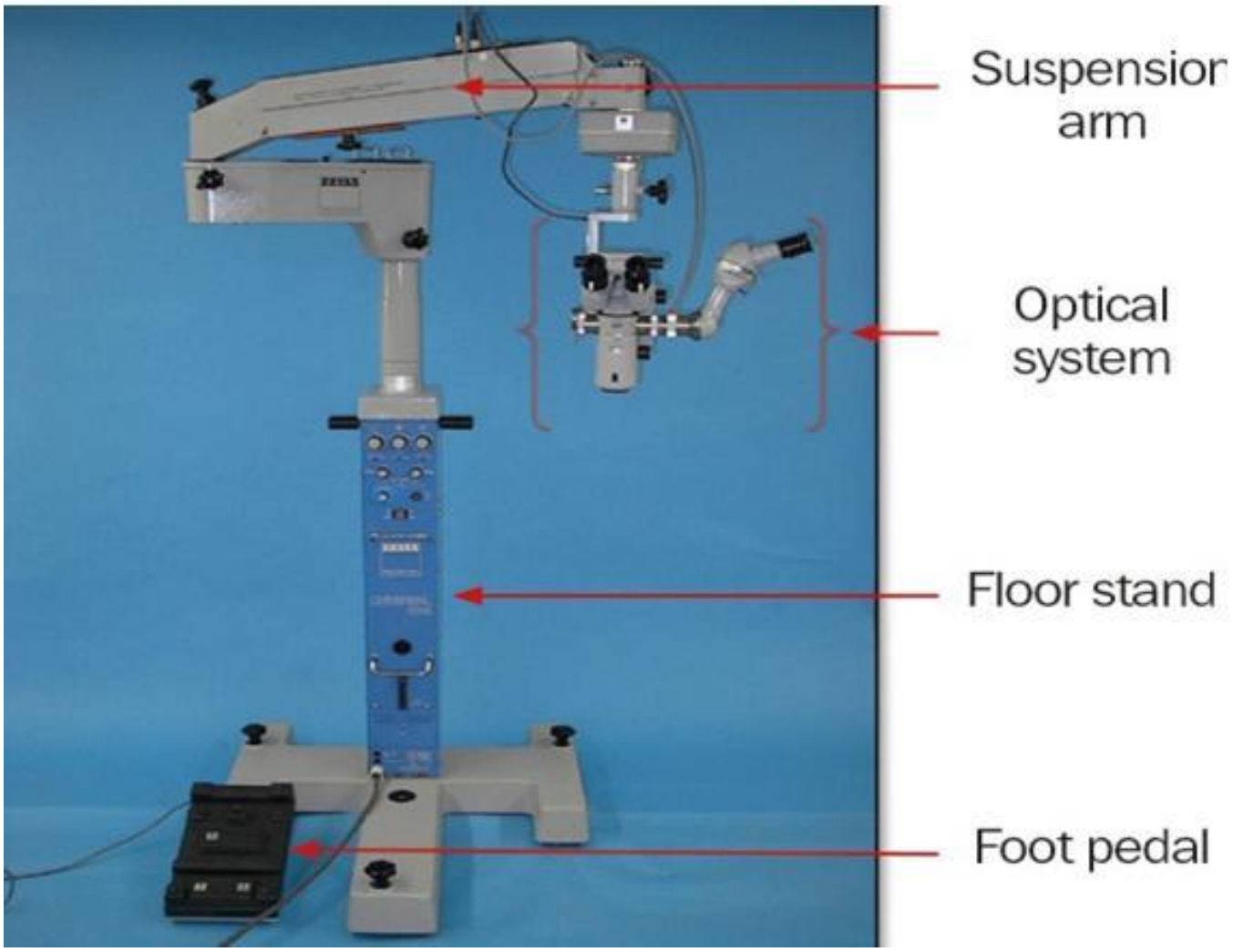


Figure 20 Stand type Operating Microscope

It is essential that all eye units develop protocols for performing microscope checks. Microscope optics should be inspected and cleaned on a weekly basis, or earlier if dirty. The entire microscope should be checked by a biomedical equipment technician at least once every six months.

MAGNIFICATION

The magnification of an image is a relative value and has to do with the size of an image as projected onto the retina of the eye (or onto a piece of film in the case of a camera). Therefore, the magnification of an image is increased by simply decreasing the distance between the eye and the object in question. Magnification is determined by the power of the eyepiece, the focal length of the binoculars, the magnification changer factor, and the focal length of the objective lens and also dependent on the magnification of the objective and eyepiece a zoom system of lenses is interposed between these two principal lenses allowing continuous change in magnification.

In the case of the human eye and the use of optical aids, such as telescopes, binoculars, etc. the base value (The real size) is simply the size of any object as it projects onto the retina from a specific distance without the help of the optical aid.

With the use of the optical aid, and without changing the distance value, the size of the image of an object can be increased on the retina. The amount of increase, then, becomes the magnification value of the particular optical aid, whether it is a telescope, binocular or microscope. A 7x binocular (or “field glass”) has the fixed value of increasing by seven fold the dimensional proportions covered by objects

on the human retina. Magnification is determined by the power of the eyepiece, the focal length of the binoculars, the magnification changer factor, and the focal length of the objective lens.

ILLUMINATION

The microscope illuminator transmits light to illuminate the surgical area. This light, like all light, can be varied. One way to vary the light, all other things being equal, is to change the voltage to the light bulb.

Light intensity is controlled by a rheostat and cooled by a fan. Light is then reflected through a condensing lens to a series of prisms and through the objective lens to the surgical field. After the light reaches the surgical field, it is reflected back through the objective lens, magnification changer lenses, binoculars and exit to the eyes as two separate beams of light. The separation of the light beams is what produces the stereoscopic effect that allows the clinician to see depth of field. Surgical microscope uses coaxial fiber-optic illumination producing an adjustable, bright, uniformly illuminated, shadow free, circular spot of light that is parallel to the optical viewing axis.

Most microscope floor stand power supplies have a provision to vary the light intensity by this method. Under the microscope, a specific amount of light will be projected and any change made in microscope magnification will have no effect on the amount of light being projected from the microscope Changes made in the magnification of the microscope do, however, increase or decrease the amount of light which will be projected back through the microscope and onto the retina of the eye of the viewer. Therefore, any increase in microscope magnification will be accompanied by a decrease in the brightness of the image as it hits the retina.

4.3. MAIN COMPONENTS OF OPERATING MICROSCOPE AND THEIR FUNCTIONS

Group activity:

• Discuss the main component of operating microscope ..

Time: 5 Minutes

The optical components of a basic stereo microscope consist of the binocular head, a magnification changer, the objective lens and an illuminator which beams light through the objective lens and onto the operating field (Figures 1 and 2). The binocular head consists of two telescopes with adjustable eyepieces for users with refractive error. The magnification can be changed by turning a knob (which selects different magnification lenses) or by using a motorized zoom controlled by a foot pedal. The working distance (Figure 1) is the distance from the microscope objective lens to the point of focus of the optical system. This value is fixed and is dependent on the chosen focal length of the objective lens. The choice of working distance depends on the type of surgery. For modern ophthalmic surgery that involves delicate work in the posterior chamber, objective focal lengths of 150 mm, 175 mm and 200 mm are commonly used The optical system often includes a beam splitter and a second set of teaching binoculars (Figure 2) so that two people can view the operation simultaneously.

The optical system is attached to the suspension arm of the floor stand (Figure 3). The suspension arm makes it possible to position the optics exactly and to fix them in place. The floor stand has wheels and can be moved around the floor and fixed into place using the brakes.

A foot pedal connected to the floor stand allows the surgeon to control the focus, the zoom, the position of the optics over the eye (the x, y position on the horizontal plane) and to turn the illumination on and off.

The illumination system is usually housed in the floor stand in order to keep the bulb heat away from the operating field. In this case, the light is transmitted to the operating field by means of a fibre optic cable. The light in ophthalmic microscopes is usually coaxial, meaning that it follows the same path as the image in order to avoid shadows.

It is essential that all eye units develop protocols for performing microscope checks. Microscope optics should be inspected and cleaned on a weekly basis or earlier if dirty. The entire microscope should be checked by a biomedical equipment technician at least once every six months.

The main microscope can be equipped with straight, inclined or tilt able binoculars on the basis of different usages. It is also with manual focusing system or motorized focusing system. The retinal protection device and red reflex module are very useful in the ophthalmic operation. In order to demonstrate or store the document, the beam splitter, observer's monocular and adaptor for CCD camera or still camera are for option.

Figure 21 Portable type

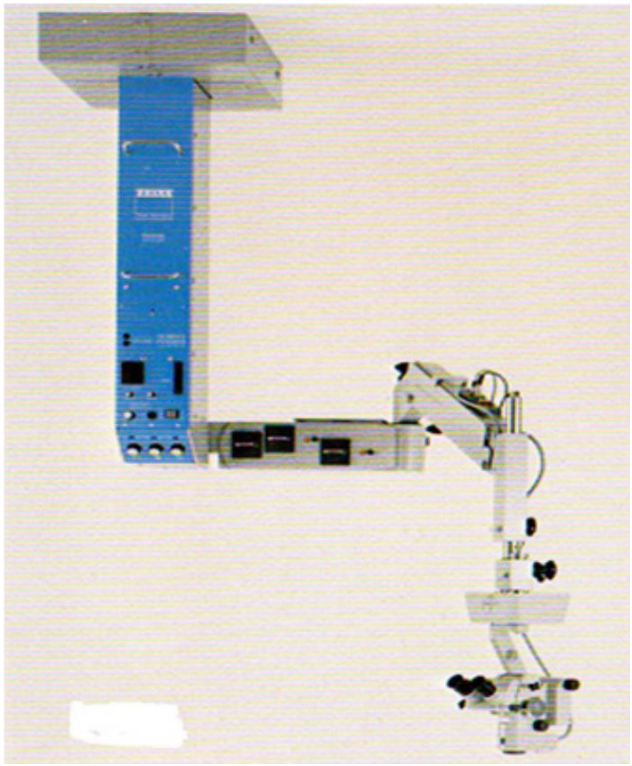


Figure 22 Ceiling type

1. Binoculars
2.Main microscope
3. Lock hand-wheel
4.Ccounter-balanced arm
5. Optic fiber cable
6.Electric cable and its connector
7.Ffixing hand-wheel
8. Lock hand-wheel
9.Connecting part
10.Column and bar
11.Flank base
12. Pedal control switch
13.Cold light source arm
14.Cconnecting screw and washer
15. Inclination handles
16.Connecting block
17.Connecting hand-wheel
18. Hand-wheel
19. Beam splitter
20.Adaptor for CCD camera
21. Connectors for power supply and pedal control switch
22. Magnification changer wheel.

4.4. GENERAL CONSIDERATIONS FOR MAINTAINING OPERATING MICROSCOPE

Group activity:

• Discuss the main steps and consideration to maintain Operating microscope…?

Time: 5 Minutes

Most ophthalmic diagnostic devices have optical components such as lenses, mirrors, and prisms. Many of these components have a special thin coating for filtering specific wavelengths of light, for reflecting light, or for reducing reflection. Great care must be exercised in handling and operating ophthalmic equipment. Consider followings:

• Dust and stains become harder to clean when they accumulate and therefore periodic cleaning is recommended. However, excessive cleaning can lead to quick deterioration of the surface coating. Specific manufacturer instructions for frequency and method of cleaning should be followed for each device. All ophthalmic equipment should be kept under dust covers when not in use.

• In regions with hot and humid climates, it is very common for fungus to grow on optical components such as lenses and mirrors. In its first stages, fungus would not be perceivable by the clinician. With time the fungus covers the lens surface in a web like manner. Initially there will be a very slight loss of image brightness, followed by decreased contrast due to light reflecting off the fungus. In its final stages, the fungus etches the outer coatings of the lens and image sharpness deteriorates. Removing fungus from lenses is extremely difficult and rarely yields good results. Ultraviolet radiation (sunlight or an ultraviolet lamp) or paraldehyde may be used to kill fungus. Once killed, the fungus may be easier to remove but the outer coatings of the lens will most likely have irreversible damage.

• Optics should be kept in a dry place with plenty of air circulation to prevent fungus growth. Air conditioners and dehumidifiers are very helpful in preventing fungus growth but if not available, the optics can be kept in a sealed container with packets of desiccant such as silica gel.

• Bulbs are common in most ophthalmic devices. When replacing bulbs, care should be taken to not touch them with bare fingers. Oils from the skin create hot spots on the bulb that can shorten the bulb's life. Additionally, fingerprints can become etched into the bulb's glass jacket and cause a shadow on the illumination field.

• Any maintenance that involves precise alignment of optics, or calibration of potentially dangerous forms of energy such as laser energy, should only be performed by manufacturer representatives or by qualified factory-trained personnel.

• Lens cleaning solution, if lens cleaning solution is not commercially available, a water-based mild detergent solution can be utilized

CLEANING THE MICROSCOPE

• It is highly recommended that the Seiler Microscopes Evolution Zoom is not exposed to dust and other contaminating substances.

• Always cover the Optical Module with the Protective Cover when the unit is not being used; Dust, dirt and stains should only be removed using a clean, moist cloth and neutral soap;

- Before cleaning the floor of the area where the unit is installed, it is very important to store the Pedal in a safe place, away from possible splashing or spattering. The Multifunction Pedal has a Handle so that it can be hung from the Column.

CARE FOR THE OPERATING MICROSCOPE

- Keep the microscope in a dry, cool and well-ventilated place to prevent fungus growth on the optics (lenses).

- Every week, clean the optics according to the optical cleaning

- Instructions described in a previous issue.

- If fungus growth is detected, clean according to the instructions described in a previous issue.

- To protect it from dust when not in use, drape a cover over the microscope. Vinyl coverings are preferred because they do not shed lint (like cloth coverings do).

- However, their use should be avoided in humid environments since they can trap moisture, which increases the risk of fungal growth.

- Wipe down the external surfaces with a damp cloth soaked in hot, soapy water.

- Cover the foot pedal with a clear plastic bag to prevent surgical and cleaning fluids from entering and damaging the electronics.

•Lift the foot pedal off the floor when washing the floor.

- Use a voltage stabilizer with the microscope. This will prevent sudden increases in voltage from destroying the bulbs and will ensure that the illumination provided

- remains constant.• Before using, test the controls of the foot pedal (the x,y movement,

- Zoom, focus, light on and off).

- Before using, check that the suspension arm can be fixed into position to ensure that it does not fall on the patient.

- Avoid kinking or bending the fiber optic cables.

- When replacing the bulbs, avoid touching them with your fingers.

- The oil left as fingerprints on the bulb can shorten its life.

- Do not move the microscope while the bulb is still hot because strong vibrations may damage the filament.

- Every six months, clean and oil the wheels and the brakes. Remove any surplus oil when done.

4.5. PREVENTIVE MAINTENANCE PROCEDURE OF OPERATING MICROSCOPE

Group activity:

• Discuss the main steps of Preventive maintenance for surgical microscope…?

Time: 5 Minutes

In this section discussion will be made about the preventive maintenance of surgical microscope. Basically the PM will be done at user's level based on the proper knowledge and skill acquired through training. Everyone should note that, any Maintenance weather it is PM or CM should be conducted based on the Manufacturers manual.

PROPER USE AND TIPS FOR OPTIMUM PERFORMANCE AND LONG LIFE

In an indirect ophthalmoscope it is the bulb that fails most frequently. The following precaution can help in prolonging its life.

- Use the bulb in the low illumination setting and increase it to high illumination setting only for brief periods when there is a need.
- If wide fluctuation in the voltage is found in the location where the instrument is being used, a spike controlled voltage stabilizer may be provided.
- The instrument should be hung using its head band only and should never be hung on a hook by its electrical cord. This may cause electrical failure.

USER LEVEL CARE AND MAINTENANCE

- Remove the dust and stain on the instrument daily.
- When not in use, keep the instrument in its box and keep the box closed.
- The head band may get oily and may also become wet with the sweat of the doctor. The instrument must be wiped clean to remove the oil and the sweat, and powdered.
- In spite of the above care, after continuous usage the foam pads of the head band may become soiled and worn out. They may be replaced with fresh extra pads.

CLEAN THE EXTERIOR AND INTERIOR OPTICAL SYSTEM

- Eyepiece
- Objective lens
- Magnification changer
- Main binoculars
- Beam splitter

REQUIRED TOOLS:

1) Lens tissue or lens paper.
2) Cotton swab or tweezers etc.
3) Blower
4) Magnifier
5) Cleaning solution: e.g. Alcohol

Caution: Do not use paper towels or other rough paper products.

Figure 23 products for cleaning of microscope optical system

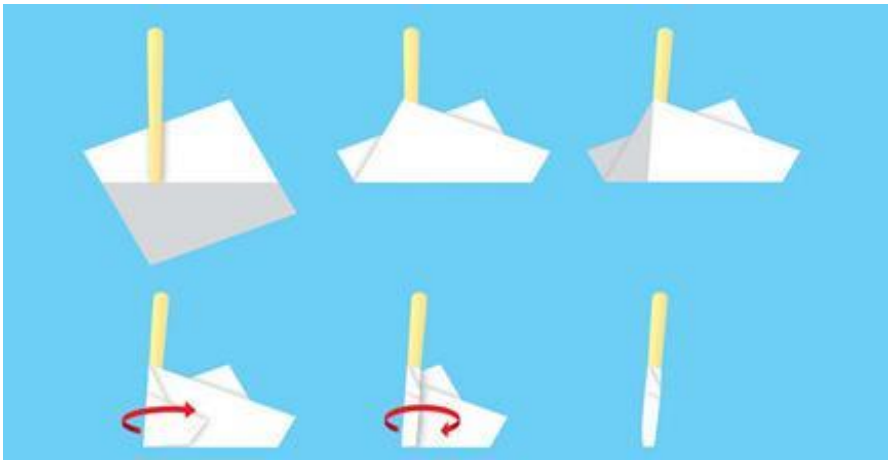


Figure 24 Wrap a sheet of lens tissue around a cotton swab as illustrated.

LENS CLEANING INSTRUCTIONS

Using nitrogen propelled compressed air or a bellows brush; gently remove dust or dirt particles from the lens surface.

- Dip the end of a lint-free cotton swab into your solvent Shake the swab to remove excess solvent.
- Beginning at the center of the lens and using a circular motion towards the outer edges, gently wipe the surface with the moistened end of the cotton swab.
- Use nitrogen-free compressed air or a bellows brush to remove any residue With a jewelers loupe (magnifier), inspect the lens for any area not completely cleaned, If not clean, use new lint-free swabs and repeat cleaning procedure.

CLEANING THE EYEPIECES

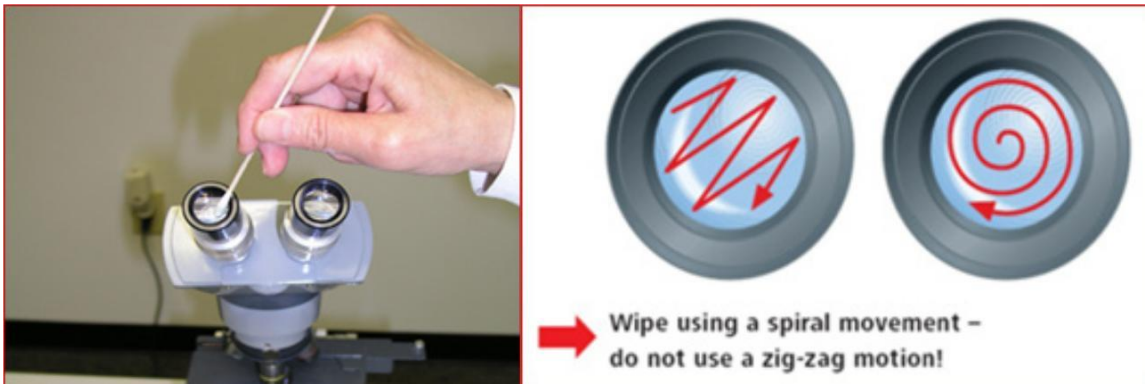


Figure 25 Cleaning the Eyepieces

- Blow to remove dust before wiping lens.
- Clean the eyepieces with a cotton swab moistened with lens cleaning solution.
- Clean in a circular motion inside out.

- Cleaning is achieved using a spiral motion from the center to the rim.
- Never wipe using zigzag movements as this will only spread the dirt.
- Direct pressure from the fingers should never be applied to the glass lens surface in order to minimize the possibility of scratching the lens if any particulates are present on the tissue.

- Wipe the eyepieces dry with lens paper.
- Repeat cleaning and drying if required.

Figure 26 Techniques for cleaning optical surfaces

CLEANING THE OBJECTIVES

- Objectives are cleaned while attached to microscope.
- Moisten the lens paper with the cleaning solution.
- Wipe gently the objective in circular motion from inside out.
- Wipe with dry tissue or lens cleaning paper .
- Be sure to clean the oil immersion objective after use.

Figure 27 cleaning the objectives

PLEASE NOTE: Never use commercially available cotton wool buds; the adhesive attaching the cotton wool to the cotton wool bud could be dissolved by the alcohol and subsequently deposited on the lenses during cleaning, there by compromising the qualities of the aforesaid lenses.

Do not remove the lenses from their holders, as this will lead to misalignment. Microscope prisms and lenses do not require frequent cleansing, apart from the Eyepieces and the Objective Lens.

- ✓ Wrap a wad of cotton wool around the end of a toothpick without using any kind of glue or adhesive;
- ✓ Slightly moisten the bud in ethanol, gently rub this against the surface of the lens in a circular motion starting at the center of the lens and moving outwards;
- ✓ Perform the circular motion again using a second dry and clean bud;
- ✓ Repeat the steps above for each lens you wish to clean.
- ✓ Lubricate and clean the connecting and suspension arms with such as:
  - Light fiber
  - Foot pedal
  - Floor stand

CARE OF ELECTRICAL SYSTEM

The switch and the rheostat in the electrical system may wear off in usage.

- Check them for smooth movement and proper functioning. Replace them if found defective.

CARE OF OPTICAL SYSTEM

As described earlier, the optical system in the vision box is well sealed so that no dust enters the box. It is enough if the exposed lens surfaces are cleaned. The instrument is so constructed that the two eye pieces slide on groves provided and as long as they are not disturbed a single image is seen, after the inter pupillary distance adjustment. If the eye pieces are disturbed and do not move in the groves provided, diplopia may be caused. To correct this, the eye pieces should be brought back to move on the groves provided.

CALIBRATION / QUALITY CONTROL

After carrying out preventive maintenance or rectifying a fault the overall functioning of an indirect ophthalmoscope must be checked to see whether it is satisfactory. While it may be difficult to establish objective standards and measurement methods, the following should be done.

1. Adjust the Eye Microscope accurately positioned perpendicular to the corneal surface.
2. Perform linear and angle measurements for Eyepiece according to manufacturer specification
3. Check the intensity of the spot. It should appear bright even in day light.
4. Check the movements of the vision box, the tilting mirror, the filters and aperture and the eye pieces. All movements should be smooth.
5. Check the movements of the knobs in the head band. They should also be smooth and at the same time provide the necessary grip at the required setting
6. Replace power supply and battery if needed

CURATIVE MAINTENANCE/REPAIR

- Substitute damaged /shorted cable
- Fit loose electrical connection
- Substitute burnt and failed switch and control
- Check Bulb and replace if burned
- Change damaged connectors and parts
- Reset alarm and volume control
- Change lights, indicators

MAINTENANCE AND SPECIAL ATTENTIONS

MAINTENANCE

- The place where the unit stays and is maintained should be clean and be faraway form the corrosive and volatile material, such as dust, moisture, acid or alkaline, etc. After the usage, the plastic dust-proof cover should be put on.
- Pay attention to keep the objective lens clean. The fingers are not allowed to touch the objective lens directly. If there is dust on the lens' surface, flick it with the clean brush. If there is some contaminative oil or stain on the objective lens, clean them by the absorbent cotton with a little mixture liquid of ethyl alcohol (30%) and ethyl ether (70%).While cleaning the lens, the mixture liquid is not allowed to permeate into the objective lens to prevent the de-gumming or mustiness.
- Optical fiber cable consists of fine glass fiber, and cannot bear bending force. If needing ending, the bending angle should be less than 90 degree to avoid the damage.

SPECIAL ATTENTIONS

- The unit belongs to Class B, grade one, and needs the power supply with good grounding while working. This aspect should be checked to ensure the safety.
- The power cable in the unit is for transferring the electricity, cannot be pulled with force.
- The power cable concerns the safety of operator, and should be protected well. If any damage on the protective-cover of power cable, please change new power cable immediately. The plug should not be wet. While moving the unit, the power cable should be winded the handle on the column.
- While change the fuse, please turn off the power.
- The pedal control switch is used for focusing, when it reaches the limited point, the focusing stops. Then, release the pedal control switch at once or run the pedal control switch in reverse direction. After the usage, do not locate the mechanical structure on the limited position to avoid any damage.
- While moving the unit, hold the handle on the column. Move the unit slowly to avoid any toppling or clashing.

- The unit with one year guarantee. If any problem, please call local a genitors maker

4.6. SAFETY PRECAUTIONS

- Do not subject the Eye Microscope to extremes of temperature. It is recommended that the device be used at temperatures of between +10° C and +40° C.
- The Eye Microscope must not be used in areas where there is a danger of explosion.
- Avoid dropping or splashing water on the device.
- The Eye Microscope must only be used by authorized persons.
- Do not attempt to move or shake the Eye Microscope with excessive force. First check whether the adjustment screws have been loosened.
- The moveable arm can move up and down between their bases. Make sure you don’t squash your hands.
- Do not open the protective cover of the halogen lamp whilst the device is in use. You could be burnt.

4.7. TROUBLESHOOTING EYE MICROSCOPE

Table 4. Basic guide for Troubleshooting of Eye microscope

Problem	Possible cause	Check and follow the steps
1.ILLUMINATION LAMP DOES NOT WORK	Cable connection is Disconnected	Check cable connection.
	Base relay cable is switched off.	Connect the cable.
	Plug of lamp house cover is switched off	Insert plug.
	POWER switch is OFF	Turn ON POWER switch.
	Brightness adjustment knob isthe minimum	Turn up brightness adjustment knob.
	Illumination lamp is broken	Replace it with a new illumination lamp Shift the On / Off switch on the Control Box to the off position and disconnect the device from the mains; • Check whether the set is hot, if it is hot, wait a few minutes until it has cooled down; • Loosen the four screws holding the Illumination Box Cover in place, and remove it; • Release the two Electrical Sockets which supply the Bulbs; • Release the two Locking Screws from the Bulb Support; • Remove the Bulb Support by pulling it out. It has a slide fitting; • Replace the burnt out bulb • Insert the Bulb Support • Connect the two Electrical Sockets, taking care not to get them the wrong way round • Assemble it again. **NOTE:** Never touch the bulb.
	Socket has deteriorated	Replace it with a new socket

2. ILLUMINATION FIELD IS NOT UNIFORM/IS SHADY/IS DARK	Filter selector lever is out of Position	Click filter selector lever
3. FIXATION TARGET LAMP DOES NOT WORK	Fixation cable is off	Insert cable
4. FUSE BLOWS	Rated capacity of fuse is Incorrect	Use fuse with correct rating & authorized fuse.
	Over Voltage from the system	Check the power source
	Internal short circuit	Check internal circuit CHANGING THE FUSES • Next to the AC cable connector on the column, there is a fuse holder. There are two fuses inside the holder. Should The device stop functioning completely, switch it off, disconnect it from the mains, open the fuse door and replace The fuses if necessary. 5A fuses should only be used.
5. FIXATION BULB DOES NOT LIGHT	The connecting cable between power source and chin-rest is not correct	Insert the power cable firmly in outlet.
	The fixation target bulb has burned out	Replace the fixation target bulb
6. BULB NOT GLOWING		_ Turn off the power supply and remove the bulb and check for continuity using a multimeter. _ If continuity exists the fault is in the electrical system. _ If not, replace the bulb. Care should be taken not to touch the new bulb with bare fingers.

6. FAULT IN THE ELECTRICAL SYSTEM	Connections and circuit boards components	Check the continuity in the fuse in the power supply. _ If the fuse has continuity and the bulb does not glow check for continuity in the connecting wires. Replace them if there is any discontinuity. _ If the fuse is having continuity and the connecting wires also have continuity and still the bulb does notglow, check the switch. If it is defective replace it. _ If the fuse is blown only, look for any obvious short circuit in the electrical system. _ If there is no obvious short circuit, replace the fuse with a fresh fuse of the correct rating specified in The instrument. _ Turn the power on. If the bulb glows, the instrument is ready for use. _ If the fuse is blown, once again there is some hidden short circuit that needs more careful investigation.
7. INDIRECT OPHTHALMOSCOPE "NOT WORKING"		1. Check input power, power supply / rechargeable cell. 2. Check the on-off switch and illumination control. 3. Check bulb using multimeter replace bulb if it is fused orblackened. 4. Check the filters – movement and locking mechanism. 5. Check and clean the condensing and image forming lenses. 6. Check the reflectors in the vision box. 7. Check the eye piece lenses and clean them if necessary. If the pieces are disturbed one mat get diplopia (double image). Positionthe eye pieces such that diplopia disappears. This has to be done bytrial and error method. 8. Is the brightness of the spot good? If not open the vision box and clean it. 9. Clean the head band. 10. Keep it in the box when not in use.

		11. A 20D, 30D or a17D lens is used with an indirect Ophthalmoscope. Clean the lens surfaces if they are dirty and keep thelens in its box. 12. Some instruments will have teaching mirror attachment. Remove them if it is not likely to be used. Keep the mirrors clean when in use. Operating microscope “not working” 1. Check the eye piece clean it if necessary, remove diplopia (double image) if it is noticed. This is done by gentle adjustment of the eyepieces by trial and error. 2. Check the IPD adjustment. 3. Check the diopter correction in the eye piece. 4. Check the objective, clean it if necessary. 5. Check the optic fiber to get good illumination. The optic fiber is a bundle of glass fiber. Handle it with care. Don’t twist it too tight. The optic fiber is to be replaced if there are significant black spots are seen in the light output. 6. Check the magnification adjustment (zoom or step type). 7. Check the foot switch (it should be kept dry you may use a plastic bag to cover it). 8. Check the X-Y movement. Check the electrical connections to the foot switch. 9. Check the different additions, beam splitter and the side scope, camera. Remove them if they are not to be used. Keep them clean when they are to be used.
		10. Check the arm movement its rotation and locking mechanism (double check it) 11. Check the up down motion and locking mechanism of the microscope head. 12. Check the wheels and locking mechanism of the microscope stand. 13. Lubricate all moving parts periodically.

		14. Keep the optics of the microscope covered when not in use. General care: Shift the microscope out of the operation theater to awry area when the theater is being washed. Bring it back only after the theater is dry. Keep a small packet of silica gel hanging near the microscope optics to absorb moisture in air. This will be necessary during the rainy seasons when the humidity in the atmospheric air is high. In such situations keeping an incandescent bulb glowing in the Vicinity (just above) the microscope will help in keeping the region round the microscope warm. This will inhibit fungus formation on the optics. Caution: Several microscopes have motorized movement of the microscope focusing system for fine focusing. This is usually achieved using the foot switch. The user must the aware of the extent of the motion. At the commencement the microscope should be at about the midpoint of the traverse so that using the footswitch one could move the microscope up or down as required. If the movement is stuck at either end pressing the foot switch more could ruin the motor.
8. CLEANING THE LENS WITH:		- Isopropyl alcohol: I have used this without problems, but prefer methanol. There are reports of it damaging optical anti-glare coatings..... - Acetone: Be VERY careful with acetone. There are only a few optical surfaces that can be cleaned with acetone (Some optical flats and mirrors used in lasers for one). Acetone can dissolve plastic, lens kitting (glue used in lens assemblies), can damage some lens coatings, etc. Use acetone ONLY if specified in writing by the manufacturer. Otherwise, you will do more harm than good.

		- Methanol: My personal favorite, it cleans well, dries quickly and I have never had problems using it on standard lenses, optical (first surface, or front coated) mirrors etc.; If not available I also use a high quality “alcohol” found in hospital pharmacy 90% alcohol) - Ammonia: No real personal experience, but it seems quite harsh to me. I’d only use it if recommended in the service manual. - Detergent solutions: Tend to leave a soapy film on optics, I only use it if I cannot get Methanol/alcohol.
9. TO REMOVE FUNGUS PRECAUTIONS		1. Don’t open (remove) the lenses mounted on components like the eyepieces. 2. Keep the humidity under control. Fungus growth is more when the humidity is high 3. Keep the space surrounding the instrument warm with an incandescent bulb glowing above the instrument. Fungus growth is inhibited when the temperature is higher 4. Keep small packets of silica gel hanging near the optics. This will ensure removal of moisture. The gel should be replaced periodically. 5. If the location of the instrument is subject to monsoon rain, give a good cleaning of the instrument including all the outer surfaces of the optics after the rainy season is over.

4.8. CHAPTER SUMMARY

- An operating microscope is an optical instrument that provides the surgeon with a stereoscopic, high quality magnified and illuminated image of the small structures in the surgical area.
- Operating microscopes are designed to provide high contrast and detailed imaging of all regions of the human eye and also are suitable for the examination and surgery in the dentistry, ENT and ophthalmology.
- Most ophthalmic diagnostic devices have optical components such as lenses, mirrors, and prisms.
- Components have a special thin coating for filtering specific wavelengths of light, for reflecting light, or for reducing reflecting. Great care must be exercised in handling and operating ophthalmic equipment's.

Chapter 5:
Ophthalmoscope, Keratometer and Lensometer

DESCRIPTION:

This chapter describes about different Ophthalmic equipment Ophthalmoscope, Keratometer and Lensometer) to have an overview for the trainer to developed their knowledge, Skill and attitude on Ophthalmoscope, Keratometer and Lensometer) maintenance. This material is prepared with both Instruction manual and checklist of activities for both the trainee and trainer. It is a training material which anticipating questions in the mind of the trainee about what he/she can do next, why it is important and where it can be found on their perspective health facilities. Also, this material will provide directions on the care and maintenance of electrical parts, optical parts and aligning optics for Ophthalmoscope, Keratometer and Lensometer).

PRIMARY OBJECTIVE

At the end of this session, the participants will be able to maintain Keratometer and Lensometer).

ENABLING OBJECTIVES:

At the end of this chapter the participant will be able to:

- Explain the purpose of indirect ophthalmoscope, Keratometer and Lensometer
- Describe working principle of indirect ophthalmoscope, Keratometer and Lensometer
- Identify the main components of indirect ophthalmoscope, Keratometer and Lensometer and their functions
- Perform user level care and maintenance of indirect ophthalmoscope, Keratometer and Lensometer
- Discuss on strategic spares of indirect ophthalmoscope, Keratometer and Lensometer

CHAPTER OUTLINE

5.1. Keratometer
- 5.1.1. Introduction to Keratometer
- 5.1.2. Working principle of Keratometer
- 5.1.3. Main components of Keratometer and their function
- 5.1.4. Preventive maintenance procedure of Keratometer
- 5.1.5. Troubleshooting and repair Keratometer

5.2. Lensoometer
- 5.2.1. Introduction to Lensoometer
- 5.2.2. Working principle of Lensoometer
- 5.2.3. Main components of Lensoometer and their function
- 5.2.4. Preventive maintenance procedure of Keratometer
- 5.2.5. Troubleshooting Lensometer

5.3. Indirect ophtalmoscope
- 5.3.1. Introduction to Indirect ophtalmoscope
- 5.3.2. Working principle and parts of Indirect ophtalmoscope
- 5.3.3. Preventive maintenance procedure of Indirect ophtalmoscope
- 5.2.4. Troubleshooting and repair Indirect ophtalmoscope

5.4. Summary

5.1 KERATOMETER

Group activity:

•What is keratometer and its applications …

Time: 5 Minutes

5.1.1. INTRODUCTION TO KERATOMETER

There is some optical equipment which by their construction and usage requires much less user level attention than the instruments described earlier. They are grouped in this chapter.

Keratometer: It is used to measure corneal power of the eyes. A picture of a keratometer is as shown in figure 28. The telescope like part (T) of the equipment can be raised or lowered by timing a knob (K1). It can be turned left or right manually by rotation around a vertical axis and fixed in any desired position by turning a knob (K2). Small left right movement in this fixed position is possible by turning another knob (K3). A keratometer, also known as ophthalmic meter, is a diagnostic instrument for measuring the curvature of the anterior surface of the cornea, particularly for assessing the extent and axis of astigmatism. It was invented by the German physiologist Hermann von Helmholtz in 1880, (although an earlier model was developed in 1796 by Jesse Ramsden and Everard Home.

5.1.2. WORKING PRINCIPLE OF KERATOMETER

A keratometer uses the relationship between object sizes (O), image sizes (I), the distance between the reflective surface and the object (d), and the radius of the reflective surface (R). If three of these variables are known (or fixed), the fourth can be calculated using the formula R = 2dI/O

Optical instrument for measuring the radius of curvature of the cornea in any meridian. By measuring along the two principal meridians, corneal astigmatism can be deduced. The principle is based on the reflection by the anterior surface of a luminous pattern of mires in the center of the cornea in an area of about 3.6 mm in diameter. Knowing the size of the pattern h and measuring that of the reflected image h′ and the distance d between the two, the radius of curvature r of the cornea can be determined using the approximate formula.

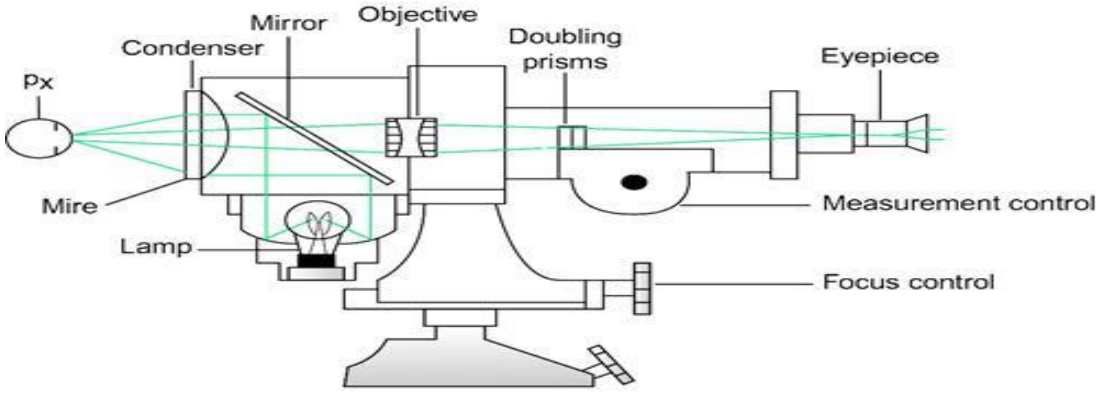


Figure 28 Keratometer schematic diagrams

In addition, a doubling system (e.g. a bi-prism) is also integrated into the instrument in order to mitigate the effect of eye movements, as well as a microscope in order to magnify the small image reflected by the cornea. This instrument is used in the fitting of contact lenses and the monitoring of corneal changes occurring as a result of contact lens wear (Fig. K2). The range of the instrument can be extended approximately 9 D by placing a +1.25 D lens in front of the objective to measure steeper corneas. The range in the other direction can be extended by approximately 6 D using a −1.00 D lens to measure flatter corneas.

5.1.3. MAIN COMPONENTS OF KERATOMETER AND THEIR FUNCTIONS

Group activity:

• Discuss the main component of keratometer..?

Time: 5 Minutes

Keratometer: It is used to measure corneal power of the eyes. A picture of a keratometer is as shown in figure below. The telescope like part (T) of the equipment can be raised or lowered by timing a knob (K1). It can be turned left or right manually by rotation around a vertical axis and fixed in any desired position by turning a knob (K2). Small left right movement in this fixed position is possible by turning another knob (K3). The telescope like part (T) of the equipment can be turned around a horizontal axis by hand.

The telescope like part (T) of the equipment can be turned around a horizontal axis by hand. The angular position can be read on a circular scale (S). Knob (K4) is used for focusing on the cornea. While making the measurements, two drums (D) provided on either side of the equipment are turned to get the coincidence in the pattern seen through the telescope. The drums are calibrated in diopter units of power of the cornea. The instrument has a bulb that provides the necessary illumination. Chin and head rests are provided in the equipment for use by the patients. Keratometers of different manufacturers look alike.

Figure 29 Keratometer

The angular position can be read on a circular scale (S). Knob (K4) is used for focusing on the cornea. While making the measurements, two drums (D) provided on either side of the equipment are turned to get the coincidence in the pattern seen through the telescope. The drums are calibrated in diopter units of power of the cornea. The instrument has a bulb that provides the necessary illumination.

A chin and head rest is provided in the equipment for use by the patients. Keratometers of different manufacturers look alike.

NAME OF PARTS

1. Protractor scale: Indicates the axis of astigmatism.
2. Adjustable eyepiece control: Adjustable from to diapers to correct for operator spherical error.
3. Horizontal knob
4. Axis rotating handle: Must be turned to locate the axis of astigmatism when there is horizontal Displacement of the + and - mire images.
5. Vertical knob: Is revolved to coincide the +and +marks of the mire images for finding the radius of curvature of the vertical axis. Vertical -, horizontal and height adjustment improve performance and focus correctly.
6. Operating Rod
7. Up-Down adjustable knob: Height of Up-Down adjustable for accurate positioning.
8. Power switch
9. Fluctuation Hand-wheel: Is revolved to coincide the-and-marks of the mire images for finding the radius of the horizontal axis.
10. Chin-rest
11. Lamp-house
12. Glare shield: Helps to maintain fixation by blocking of no measured eye.
13. Headrest

Figure 30 parts of Keratometer

14. The instrument efficiently measures the radius of curvature of the anterior corneal surface. One position measurement is not only more accurate but is truly effective in reducing measuring time and also helps promote patient's cooperation. The brightness of all three images is equal. The central image is double whenever the instrument is not focused precisely on the corneal mire image. This allows continuous monitoring of correct focus by the examiner.
15. Internal scale reading system. Beside the mire images, the millimeter scales for the radius of curve. Radius of curvature and the diaper scales for corneal refractive power are view at all times in the field of view.
16. Measurement of corneal astigmatism Horizontal displacement of the mire images indicates existence of astigmatism and axis rotating handle is used to coincide the measuring head with axis, after which the vertical and horizontal knobs are used to coincide the mire images, showing the great case and simplicity of one position measurement.

5.1.4. PREVENTIVE MAINTENANCE PROCEDURE OF KERATOMETER

Group activity:

- **Discuss the main steps and consideration to maintain Keratometer…?**

Time: 5 Minutes

USER LEVEL CARE AND MAINTENANCE

Remove the dust and stain on the equipment including the optical parts and external surfaces, only as described in Chapter2.

- When not in use, turn the power off and keep the equipment covered.
- Occasionally when the power is turned on, there may be no light.
- The bulb may have fused or there may be some fault in the electrical system.

Forth is, the procedure described for slit lamps (part I) may be followed.

Besides keeping the instrument clean, other important maintenance work will be to lubricate all moving parts so that movement of all the knobs and drums is smooth.

CHECKING CALIBRATION

A set of three electroplated standard balls of precisely known radii (corresponding to known corneal powers) are available. Any one of the balls may be used to check the calibration of the keratometer. In case the drum reading is different from the known power of the steel ball, the screw holding the drum is to be loosened, and the drum set at the correct reading and the screw tightened again. The calibration may be verified using the other two steel balls.

5.1.5. TROUBLE SHOOTING AND REPAIR

Symptoms	Cause
1. No mire image	Has the fuse blown?
2. Head scale image damaged	Main lamp damaged? Has the scale lamp?
3. Head rest does not move up or down	The rod of headrest needs Grease?

5.2. LENSOMETER

Group activity:

• What is Lensometer and its applications …

Time: 5 Minutes

CONTENTS TO BE COVERED UNDER THIS UNIT:

1. Introduction to Lensometer
2. Description and use of Lensometer
3. User level care and maintenance of Lensometer
4. Checking and calibration of Lensometer
5. Strategic spares of Lensometer
6. Care of mechanical system of Lensometer
7. Care of electrical system of Lensometer

5.2.1. INTRODUCTION TO LENSOMETER

Lensometry is an optical bench consisting of an illuminated moveable target, a powerful fixed lens, and a telescopic eyepiece focused at infinity. The key element is the field lens that is fixed in place so that its focal point is on the back surface of the lens being analyzed. The lensometer measures the back vertex power of the spectacle lens. The vertex power is the reciprocal of the distance between the back surface of the lens and its secondary focal point. This is also known as the back focal length. For this reason, a lensometer does not really measure the true focal length of a lens, which is measured from the principal planes, not from the lens surface. The lensometer works on the Badal principle with the addition of an astronomical telescope for precise detection of parallel rays at neutralization. The Badel principle is Knapp's law applied to lensometers.

5.2.2. WORKING PRINCIPLE OF LENSOMETER

Group activity:

• What is lensometer and its applications …?

Time: 5 Minutes

It is used to measure the focal powers of lenses (spherical, cylindrical and sphero cylindrical) It can also determine the de-centration in the lens. There are two generic models of the instruments. One in which the target seen through the eye piece of the instrument consists of a number of bright points form in gap circle, and another in which the target has asset of three wide lines with wide spacing between the Mandan other set of three narrow lines with smaller spacing between them. These two sets of lines inter sect at right angles. The equipment comes in different shapes. A picture of a typical lensometer, also known as foci meter, is shown in figure 31. The equipment has a clamp(C) for mounting the lens whose power is needed. There is provision form a king in kdotson the lens at the desired points. For measuring the power of the lens, a calibrated disc (D) is turned till a clear and sharp image of the target is seen through the eye piece (E). For measuring the focal power of cylindrical and sphero cylindrical lenses that have different powers in different meridians, the optics of the equipment can be rotated around the axis. The angular position can be seen on a circular scale(s) on the instrument.

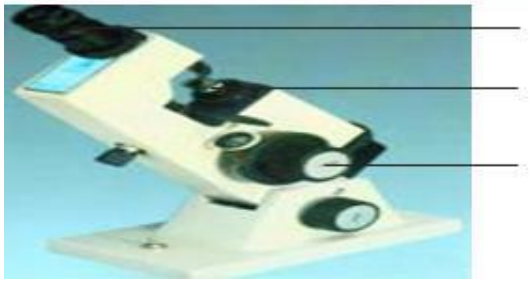


Figure 31 Lensometer

5.2.3. MAIN COMPONENTS OF LENSOOMETER AND THEIR FUNCTIONS

LENSOMETER – instrument designed to measure the prescription of an optical lens.

MIRES – lines, thick and thin used as measurement images.

POWER DRUM OR POWER WHEEL –dial used to determine lens power.

PLATFORM- stage the frame rests on when lenses are being neutralized Instrument consists of an ocular for viewing the mires, a flat stage or table for supporting the spectacle frame, a power dial, and an axis wheel.

SPHERE – lens with optical power being the same in all meridians (conveyed in diopters).

CYLINDER – lens that has different refractive/optical power in each meridian. It is used to correct astigmatism.

AXIS – meridian of cylinder with the minimum power perpendicular to maximum power meridian. Expressed in degrees.

PRISM - a transparent, wedge shaped material with two flat surfaces inclined at a given angle that connect at a point called the apex. The two connected surfaces are resting on the base of the prism. Prisms are used to help the eyes to work together by bending or refracting light.

LENSOMETER FUNCTIONS

The function of a Lensometer is to determine the characteristics of a lens, including:

1. Power
2. Optical Center location
3. Major Reference Point location
4. Prism power/direction
5. Cylinder axis orientation

The Lensometer is also used to place marks on a lens to ensure proper placement of the lens during the fabrication process.

Identification of Major Parts

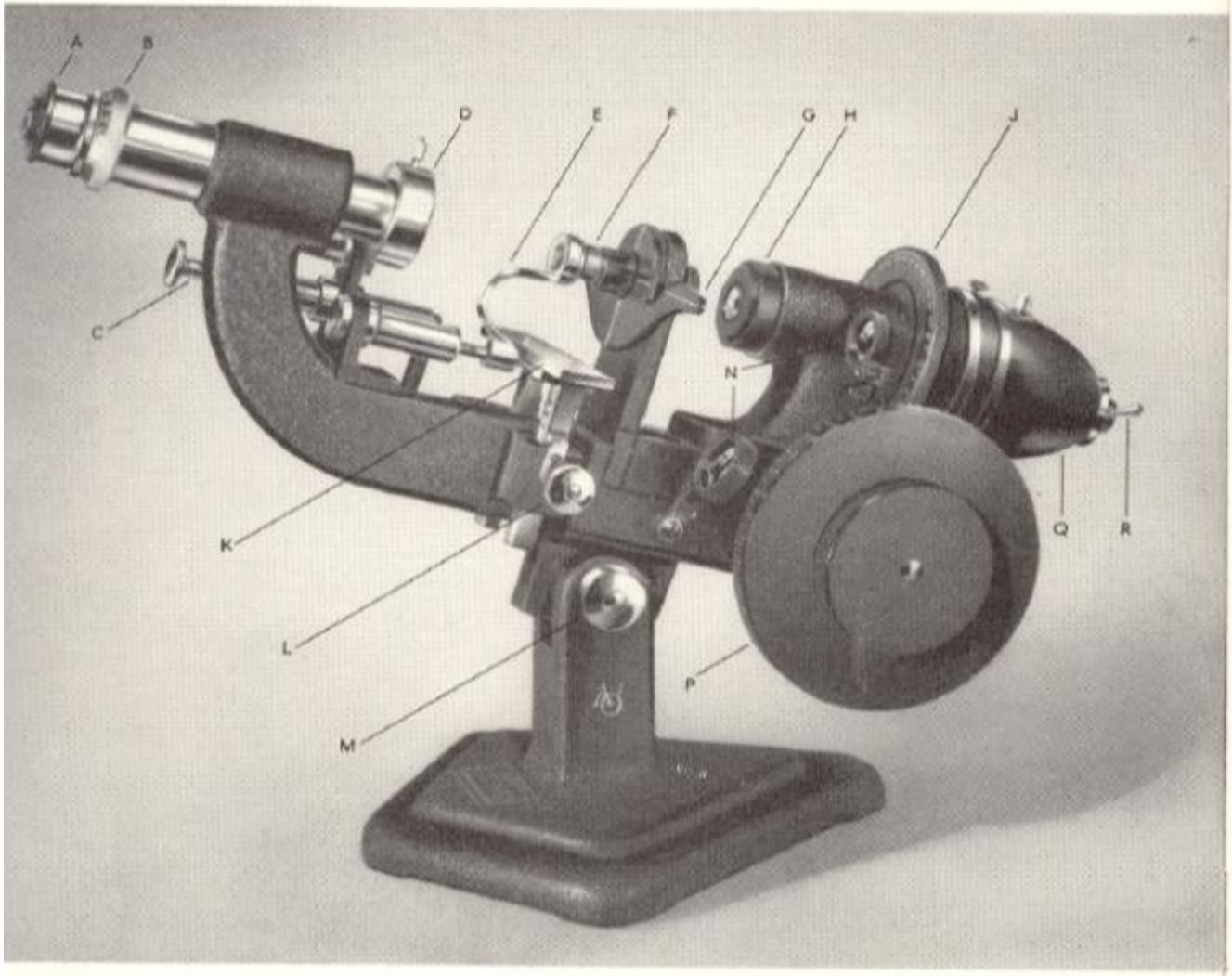


Fig. 1

A. Adjustable eyepiece.
B. Prism measurer.
C. Lens marker.
D. Auxiliary prism holder.
E. Lens holder.
F. Lens positioning tube.
G. Lens alignment plate.
H. Target.
J. Protractor wheel.
K. Lens alignment table.
L. Alignment table adjustment knob.
M. Height adjustment.
N. Magnifiers.
P. Power wheel.
Q. Lamp housing.
R. Toggle switch.

Figure 32 Detailed Lensometer Parts

5.2.4. PREVENTIVE MAINTENANCE

Group activity:

•Discuss the main steps and consideration to maintain Lensometer…?

Time: 5 Minutes

These preventive maintenance instructions were prepared to aid you in keeping your Lensometer in perfect working condition. The Lensometer is a precision instrument and must be operated and maintained with utmost care. By following these directions, the operator can insure long life and trouble-free operation.

MAINTENANCE "MUSTS'

- ✓ Keep Lensometer covered when not in use, to prevent dust accumulation on working parts.
- ✓ Clean Lensometer periodically, with especial care for the guides on which the target assembly moves.
- ✓ Caution: Avoid moving fingers along these guides as there may be sharp edges.
- ✓ A small brush will simplify cleaning.
- ✓ Clean sliding parts with benzene if they do not work smoothly.
- ✓ This cleaner, or a similar solvent, will remove any collected gum.
- ✓ Do not "overdose" with solvent.
- ✓ Do not lubricate any sliding parts.
- ✓ Lubricants collect dirt and dust particles and tend to form gum residues.
- ✓ Do not under any circumstances change any adjustments of the optical system.
- ✓ Replacement lamps may be inserted by removing the lock screw in the top of the lamp housing (Q from Fig 25) and sliding the entire housing off.
- ✓ This Lensometer uses a 10-watt frosted lamp with intermediate base.
- ✓ Lack India ink, or some ink similar to types, is used with the Lensometer. There should at all times be enough ink in the ink holder to moisten the roller pad as it rotates.
- ✓ Points of lens marking device (C) should be kept clean to obtain small dots and insure accurate marking.
- ✓ Eyepiece (A) should be dusted periodically with a camel's hair brush to remove dust particles. Lens may then be cleaned with lens cleaning fluid and soft cloth.

Removal of dust and stain, if any, Cleaning the optical surfaces at the front and reared lubrication of moving parts and keeping the equipment under cover when not in use are the user level maintenance functions. Checking the bulb and electrical faults if any, when the bulb in the instrument is not glowing when turned on, is another maintenance function to be carried out as described earlier. The maintenance function exclusive for this equipment will be keeping the in pad moist. Strategic spares and tools: Same as in the case of Lensometer.

Care of Mechanical System: -All mechanical movements should be checked periodically and gently lubricated. The cast or wheels of a microscope stand should run smoothly. It will be good to replace them as a set when any one or more of the cast or sis worn out or sticky.

Care of Electrical System: The electrical system should be checked periodically. Any defect noticed, like a loose connection, damage to insulation in the electrical wires, etc., should be rectified immediately. The cooling fan should run smoothly. They should run in such a direction as to suck air out of the instrument.

Sometimes due to some mistake in electrical connections the fan may run in the opposite direction and suck air into the instrument. This will result in dust getting into the instrument and should be avoided.

DON'T MOVE ANY OPHTHALMIC EQUIPMENT WHEN THE POWER IS ON. EVEN GENTLE VIBRATION MAY CAUSE THE LAMP FILAMENT IN THE BULB TO BREAK

5.2.5. TROUBLESHOOTING AND SAFETY OF LENSOMETER

Your lensometer is finest precision lens measuring instrument of its type available. Its accuracy depends largely upon moving parts which are fitted to extremely close tolerances. Since the lensometer subjected to at most constant use, these mated parts are bound to wear. Such wear accentuated by failure to properly clean and lubricate the instrument periodic ally.

To date, thousands of lensometer are in use all over the world. These added recommendations are being made. In the Interest of prolonging their useful life through the care such a precision instrument so justly deserves. By carefully performing the following procedures, the life of the Lensometer can be extended significantly.

1. Always cover the Lensometer after use.
2. CLEAN AND LUBRICATE THE FOCUSING SIDEWAYS AT LEAST ONCE AWEEK. Be certain to follow the recommendation as given In the next section.
3. Clean lubricate the Inking Device plunger and both guide tubes once a week.
4. About once a month a few drops of oil should be put on the power wheel. For effective lubrication, place a few drops of oil where the axle goes through the main casting on both sides of the drive gear. The drive gear is exposed after the target carrier is removed from the instrument.
5. The Ink Roller will give much longer service if kept wet with Ink at all times. In addition, It is advisable to thoroughly wash the roller felt once a week with soap and water.
6. Since dust can accumulate on the lenses surface inside the collimator nose piece, an occasional cleaning is necessary to maintain a clean and sharp image. Most of the dust can be from by blowing air into the aperture with a rubber syringe.
7. Keep optics free of fingerprints as they have a damaging effect upon polished optical surfaces, and dirty lenses form a poor target image.

To do a thorough Job of cleaning and lubricating the focusing slide ways, the target carrier assembly must be removed from the instrument.

- On the left side near the back of the main casting is flat headed stop screw which limits the minus focusing excursion. Remove the top screw.
- Turn the Power wheel until the target carrier rack is disengaged from the pinion drive gear. Slide target carrier assembly off of the instrument.
- Thoroughly clean the main slide ways and target carrier slides with rather stiff bristled artist's brush soaked with any good grease cleaning solvent, such as Stoddard Solvent. Wipe with dry a clean cloth.
- Lubricate the main slide ways on both flat and angled surfaces a thin coat of grease.
- Reassemble the target carrier to the instrument. DO NOT FORCE the mating slide surface together.

With slight forward pressure shift the position of the target carrier until it is aligned with the main slide ways. The target carrier can then be pushed rather easily on to the instrument.

- Then re-engage the rack with pinion drive gear. Make certain eyepiece is properly focused and check power wheel zero reading to verify gear tooth engagement.
- Replace the flat headed stop screw which was removed in step a.
- Run the target back and forth through its entire length of travel several times to distribute the grease evenly over the slide ways. Wipe off any excess grease that may pileup at the slide travel.
- Proceed to clean and lubricate the inking device and plunger using some solvent and grease used on the slide ways.

5.3. INDIRECT OPHTHALMOSCOPE

CONTENTS TO BE COVERED UNDER THIS UNIT:

1. Description and Purpose of ophthalmoscope
2. Description of major subsystems of ophthalmoscope
3. The Illumination System of ophthalmoscope
4. The Electrical System of ophthalmoscope
5. The Vision Box of ophthalmoscope
6. The Head Band of ophthalmoscope
7. Preventive maintenance ophthalmoscope
8. Care of Electrical System of ophthalmoscope
9. Care of Optical System of ophthalmoscope
10. Preventive maintenance schedule of ophthalmoscope
11. Check list for preventive maintenance of ophthalmoscope
12. Trouble shooting and repair of ophthalmoscope

Group activity:
1. What is Indirect Ophthalmoscope and its applications ..
2. What is the difference between direct and indirect ophthalmoscope….?

Time: 5 Minutes

5.3.1. INTRODUCTION TO INDIRECT OPHTHALMOSCOPE

It provides a wider view of the inside of the eye. Furthermore, it allows a better view of the fund us of the eye, even if the lens is clouded by cataracts. An indirect ophthalmoscope can be either monocular or binocular. It is used for peripheral viewing of the retina.

5.3.2. WORKING PRINCIPLE OF INDIRECT OPHTHALMOSCOPE

The modern Indirect Ophthalmoscope functions as the eye piece of a stereo-microscope for which a hand held high positive aspheric lens (17D, 20D or 30D) serves as the objective. When viewed properly, a magnified image of the retina is seen.

Some of the advantages of the instrument as com-pared to the direct ophthalmoscope are:

1. Stereoscopic view
2. Greater field of view
3. Increased illumination and
4. Reduced distortion.

An additional advantage is that the doctor is at distance from the patient. However, the final image seen is inverted and the magnification is much lesser than in a direct ophthalmoscope.

Description of major subsystems: An indirect ophthalmoscope has four major subsystems.

1. An illumination system
2. An electric system
3. A stereoscopic viewing system (vision box)
4. A head band that supports the illumination system and the vision box.

All models of the indirect ophthalmoscopes are similar in construction. A picture of Indirect Ophthalmoscope is shown in

figure33

Figure 33 Indirect ophthalmoscope, A. Top- head band mounted, B- Bottom spectacle mounted

THE ILLUMINATION SYSTEM: This consists of a tungsten filament lamp or a halogen lamp and affront silvered concave reflect or suitably positioned behind the lamp. Two condensing lenses are placed in front of the lamp. The lens close to the lamp is fixed while the other lens could be moved forward or backward and fixed in position with the help of a spring loaded screw. There is provision for introducing filters of required characteristics in the path of the light. The light coming through the second lens is reflected using affront silvered mirror to provide the illumination at the eye of the patient. The mirror could be tilted and fixed in any required position for easy examination. The size of the spot could be varied by pushing in stops of different sizes in the path of the light near the bulb.

THE ELECTRICAL SYSTEM: This consists of a step down transformer provided with a switch, a rheostat, a fuse and a sufficiently long connecting cable. The transformer is either fixed on the wall near the examination table or kept in the box of the instrument.

THE VISION BOX: This has two eye pieces. They can be moved laterally in the vision box to match with the inner pupillary distance of the doctor. The hand held high power positive aspheric lens gives a real inverted image of the patient's retina in space in front of the lens. The light from this image meets a 90° wedge formed by two mirrors in the vision box. The wedge divides the beam into two beams which are further reflected by two 45° mirrors (or total reflecting prisms) before they reach the eye of the doctor through the eye pieces.

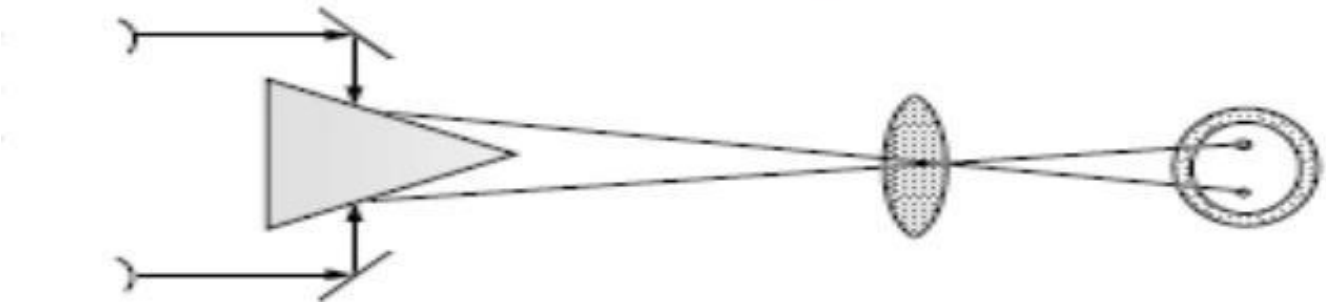


Figure 34 Schematic of vision box

The ray diagram indicating the working of vision box is as shown in figure34.The vision box is rigidly attached to the illumination system. This is usually well sealed so that no dust enters the box.

Figure 35 Teaching attachment

In some instruments, a pair of semi-silvered reflectors can be fixed in the vision box. These are known as teaching attachments. They are useful for assistants (students) to look at what the doctor is looking at. The picture of an indirect ophthalmoscope with this attachment is shown in figure 35

The Head Band: The illumination system and the attached vision box are attached to a head band that a doctor can wear conveniently. The cable for the lamp is also attached to the head band. The illumination system, vision box combination could be tilted and fixed at the desired position using screws on the head band. While in use, the eye pieces are as close to the doctor's eyes as possible to give a wide field of view. The illumination system and the vision box are also attached to a spectacle frame. The box provided for the instrument is such that when not in use the instrument together with the head band and the cables could be kept in marked positions in the box. Sometimes, the instrument with the head band is kept hanging on a hook on the wall near the examination area. Since the examination using indirect ophthalmoscope is done without any external light, one can arrange such that when the ophthalmoscope is removed from its hook the room light is turned off and the light is turned on when the instrument is back on its hook.

5.3.3. PREVENTIVE MAINTENANCE

Group activity:

➢ **Discuss the main steps and consideration to maintain Indirect ophthalmoscope**

Time: 5 Minutes

Care of Electrical System: The switch and the rheostat in the electrical system may wear off in usage.
Check them for smooth movement and proper functioning. Replace them if found defective.

Care of Optical System: As described earlier, the optical system in the vision box is well sealed so that no dust enters the box. It is enough if the exposed lens surfaces are cleaned. The instrument is so constructed that the two eye pieces slide on groves provided and as long as they are not disturbed a single image is seen, after the inter pupillary distance adjustment. If the eye pieces are disturbed and do not move in the groves provided, diplopic may be caused. To correct this, the eye pieces should be brought back to move on the groves provided.

Preventive maintenance schedule: Suggested frequency - once a week.
Check list for preventive maintenance:

- Do you get a clear spot of light when the instrument is turned on and the light beam is obtained on the wall or table top at a distance of one meter?
- Does the brightness of the spot vary when the brightness control knob is operated?
- Do the filters move in and out of the path of the beam as desired?
- Do you see a single image while looking through the eye pieces?
- Do the head band fittings move freely when the knobs are turned?
- Does the spectacle fit properly in the case of spectacle mounted instruments?
- The answer to all these should be “yes”. If not, action should be taken as described under trouble shooting.

5.3.4. TROUBLESHOOTING AND REPAIR

Bulb not glowing:

- Turn off the power supply and remove the bulb and check for continuity using a multimeter.
- If continuity exists the fault is in the electrical system.
- If not, replace the bulb. Care should be taken not to touch the new bulb with bare fingers.

Strategic spares:

- A spare bulb
- A spare fuse

Tools needed:

- Multimeter
- Watch makers screwdriver set
- Watch makers wrench set
- Soldering rod and solder
- Optics cleaning supplies
- Cloth and powder for cleaning headband

5.4 CHAPTER SUMMARY

- Keratometer is a diagnostic instrument for measuring the curvature of the anterior surface of the cornea, particularly for assessing the extent and axis of astigmatism. It is used to measure corneal power of the eyes.
- A keratometer uses the relationship between object sizes (O), image sizes (I), the distance between the reflective surface and the object (d), and the radius of the reflective surface (R).
- Lensometry is an optical bench consisting of an illuminated moveable target, a powerful fixed lens, and a telescopic eyepiece focused at infinity.
- The lensometer works on the badal principle with the addition of an astronomical telescope for precise detection of parallel rays at neutralization.
- It is used to measure the focal powers of lenses (spherical, cylindrical and sphero cylindrical) It can also determine the de-centration in the lens.
- Indirect Ophthalmoscope provides a wider view of the inside of the eye. It allows a better view of the fund us of the eye, even if the lens is clouded by cataracts.

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