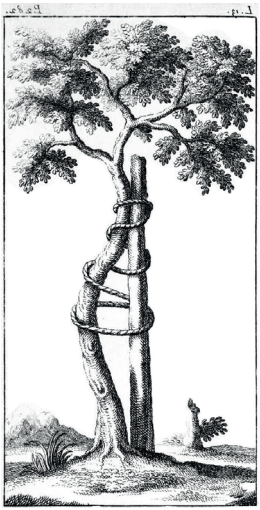
Laboratory / Workshop / Clinical



Principles, Procedures

and

Safety Instructions for Machines and Tools

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This book is aimed at providing guidelines on principles, regulations and safety instructions to be adhered too and observed by clinicians and practitioners in the field of prosthetics and orthotics, students pursuing different levels of prosthetics and orthotics studies, Instructors/Lectures and other members of the team working in different rehabilitation centers

Table of Contents

Definition of Terms, Terminologies and Phrases

- **Client**
  This term is used mainly to address a person who receives health care in an ambulatory care setting, especially when health maintenance rather than illness care is the primary service provided. Sometimes this term is preferred to denote a collaborative relationship rather than a hierarchical one.

- **Patient**
  A patient is any recipient of health care services. The patient is most often ill or injured and in need of treatment by a physician, advanced practice registered nurse, physiotherapist, physician assistant, psychologist, dentist, podiatrist, veterinarian, or other health care provider.

- **Clinician**
  A clinician is a health care professional that works as a primary care giver of a patient in a hospital, skilled nursing facility, clinic, or patient's home. A clinician diagnoses and treats patients. For example, physicians, nurse practitioners,Clinical pharmacist and physician assistants are clinicians; a speech-language pathologist is a clinician, a speech-language pathology assistant is not.

- **Quality Management**
  Quality management in line with a prosthetics and orthotics facility or training, ensures that an facilty or an institution, product or service is consistent. It has four main components: quality planning, quality assurance, quality control and quality improvement. Quality management is focused not only on product and service quality, but also on the means to achieve it.

- **Safety Management**
  Safety management system is a comprehensive management system designed to manage safety elements in the workplace. It includes policy, objectives, plans, procedures, organisation, responsibilities and other measures. The SMS is used in workshops, industries that manage significant safety risks.

- **Practical Practice**
  This is relating to, or manifested in practice or action: not theoretical or ideal a *practical* question for all *practical* purposes

1. Introduction

The development of quality and safety policy for students and staff practicing in prosthetics and orthotics profession would not have been possible to outline if it were not due to challenges experienced over a long period of time of observing the deficiencies in quality of training, service provision and safe practice in both patients/clients and the professionals. These challenges are as a result of great inputs from the students, staff, external professional advisors/consultants in identifying the weakness in quality training and practice in prosthetics and orthotics practice. A number of professionals, i.e. Mr. W. Raab, Ms. E. Figgins, Mr. C. Tardif, Mr. S. Sasaki, Mr. B. Malas, Mr. J. Moshy, etc. has extensively not only contributed in emphasizing the establishment of the quality and safety policy but also ensuring quality and safe practice is adhered to of which training and services is attained at the highest possible level.

Researchers and manufacturers have continued to concentrate their efforts on availing optional materials, components, parts, developing technologies of the art and advancing knowledge, skills attitude of clinicians and practitioners as a means of presenting different options and approaches of rehabilitating persons with physical disabilities.

In line with these developments, there are an increasing number of patients worldwide who have improved their quality of life through the use of assistive devices with these available options and approaches in the market. In order to keep pace and cope with the current developments, the clinical adoption and quality of training professionals is of an extremely high importance as it is the basis of rendering optimum quality of services.

The principles, procedures and safety adherence while using prosthetics, orthotics tools, machines, equipment's and materials in line with the national and international standards set up in other vocational and similar profession as well as experienced gained in other visited institutions, i.e. Bundes Fachschule für Orthopädie Technik, (Germany); Prosthetics & Orthotics Department, Oslo University, Norway; Prosthetics and Orthotics Department, Comprehensive Community Based Rehabilitation Hospital, Dar es salaam, Tanzania, etc.

Fig-1: Prosthetics and Orthotics Department CCBRT, Dar es salaam, Tanzania

In reference to ***Fig-1*** above, provides an example of a well-organized, layout of tools, equipment, machines and furniture as the first initial attempt of a guarantee of an adherence of the day to day principles, procedures and safe practice. Such an orderly arrangement alerts one on missing s seen on a marked board, draw or a table which also serves as a measure of precaution of losing items, stepping in loosely placed tools, equipment, materials and therefore protects oneself from any injury.

It has been experienced that, with given time, if such a system is implemented from the beginning, an adherence to an orderly manner will always be intact and hence improve oneself safe practice.

2. Institutional/Centre Quality Management

Although this book is geared in providing a clear description of principles, procedures and safety instructions for students, clinicians and practitioners in the field of prosthetics of orthotics, one cannot avoid in referring to the essences of quality management of an institution/centre.

Implementing a quality management system in a prosthetics and orthotics institution or centre affects every aspect of its performance. The two overarching benefits to the design and implementation of quality management systems include:

- Meeting the student or client's requirements, which helps to instill confidence in the institution/centre, in turn leading to more student, client satisfaction, higher demand of opportunity, service and dissemination of good services offered to the community and society at large.
- Meeting the institutional/centre requirements, which ensures compliance with regulations and provision of opportunity and services in the most cost and resource-efficient manner, creating room for expansion, growth, and profit

Within these overarching benefits are advantages like helping to communicate a readiness to produce consistent results, preventing mistakes, disastrous, healthy free risk, reducing costs, ensuring that processes are defined and controlled, and continually improving the institutional/centre offerings.

Fig-2: Optimal Layout of Equipments, Machines and organisational structure, CCBRT, Dar es salaam, Tanzania

The ultimate objective of training and service provision institution in prosthetics and orthotics is to train and qualify professionals through an institutional wide-approach of clearly understanding the students, staff and client's needs and attempting to act promptly on solutions.

This in turn outlines an effective process on implementing education, training and service provision of different categories of students who know how to use and handle patients, prosthetics and orthotics technical consumables, workshop/hand tools, machine tools and equipment, (***Fig-2***).

The system in place is also intended to measure or analyze the performance and the continual improvement of the student's performance, quality of services delivered and the processes that is used to achieve the overall objective.
The principles in quality management are to be used as a framework to guide the institution/service facility and all those who are involved in improving the performance of students and quality of services.

One of the procedures which is taking place in one of the workshop as reflected on (***Fig-3***) is not only that it is of an extremely poor quality but it is very dangerous to one's healthy. The table has been filled up with dirty which is never cleaned and that its change in reaction due to climate change is alone a disastrous. It should also be noted that, none of the clinician, student has protective gears and therefore they are all exposed into inhaling resin fumes and fibers from the carbon fiber, stockinet's, skin damage, etc. Please note also that, they have an excellent infrastructure, well designed building and equipped department but extremely badly used. This is an example of a department whereby people are not at all consensus about, organizing their workshop, tools, machines, procedures are not in order and the quality management system is not in place at all.

Fig-3: Poorly organisation of workplace, tools, equipment and procedure

2.1 Students, Clinicians and Collaborating Partners Focus

The institution/centre is solely dependent on the students, clinicians, practitioners and collaborating partners for its long term sustainability. It is therefore the duty of the team managing the institution/centre to clearly understand the current and future requirements in order to strive to exceed the expectations of the students, clinicians, practitioners, patients, collaborating partners and candidates aspiring to join the centre in future. This will lead to an increased financial viability, effectiveness of utilizing institutional resources and loyalty of clinicians, students, patients and collaborating partners.

2.2 Institutional Leadership

The leadership of the institutions/centres are striving to establish unity, direction of the institution/centre, create and maintain internal environment in which staff and students become fully involved in achieving the institutional/centre objective. This will lead to a motivated team of implementing the institutional goals and objectives as the activities are evaluated, aligned and implemented in a unified manner. There will also be low level of miscommunication in implementing different procedures, curriculum and other training related activities.

2.3 Team Approach

The centre believes that students and staff at all levels are the essence of the institution and their joint and full involvement enables their abilities to be used for the institutional benefit. People become innovative, creative in furthering the organization objectives, accountable for their own performance and eager to participate in and contribute to continual improvement.

2.4 Procedures of Practicing and Training Approach

The desired of clinicians, practitioners and students performance result or service is achieved more efficiently when service provision activities and training and the related resources are managed through a defined process. Such a process lowers the costs through effective use of resources, consistent and predictable results as well as focused and prioritized improvement opportunities.

2.5 Systematic Approach to Management

In many scenarios, the process are multiple and therefore, identifying, understanding and managing interrelated processes as a system contributes to the institutional effectiveness and efficiency in achieving its objective. This provides room for an integration and alignment of the process that will best achieve the desired results, ability to focus effort on the process and providing confidence to interested parties as the consistency, effectiveness and efficiency of the institution.

2.6 Continual Improvement

Continual improvement of an institutional overall performance is a permanent objective which should be revised after every specified period of time. It has a flexibility of reacting quickly to opportunities and performance advantages through improved institutional capabilities.

2.7 Factual Approach to Decision Making

The concept of effective decision are based on the analysis of data and information whereby informed decision are arrived at, increased ability to demonstrate the effectiveness of past decisions through references to factual records and increased ability to review, challenge and change opinions and decisions.

3. Safety Practice

Safety can basically be defined as principles and procedures adopted in a working environment aimed at reducing the risk of endangering ones health to as lower a level as it can be possibly be achieved.

In order to ensure that such a practice is in place, it is required to set the intended goals to be achieved, planning and measuring the performance with given time. In other words there must be a system which is in place which should be included in the normal norms of practice within the prosthetics and orthotics facility. Safety Management like any other system in a working environment has an implications on ethical issues, set-up rules, regulations and direct or indirect financial burden.

In order to implement an effective safe practice and in adhering as well as observing to its implications, the following principles should be clearly defined:

- Outlined organizational structure to manage risk
- Identification of workplace risk and implement suitable control
- Ensure there is a sound and set-up effective communication within the entire centre
- Ensure there is a formally and consistently outlined procedure of identifying, noting, registering and prompt acting on all without failure

- Ensure there is a follow up and a consistent process to be followed over through the existence of the Centre

3.1 Safety Concepts

In reference to the components of management system promoted by the International Labour Organization (ILO), a prosthetics and orthotics training facility, service facility as well as rehabilitation centre could use the same basic components which will provide a clear concept of implementing the system, i.e.

- **Policy**
  This includes outlining statement in respect to the requirements of the organization in reference to resources, defining management commitment and institutional target

- **Institution/Centre**
  Outline clearly the institutional/centre structure in which responsibilities and accountabilities are defined, i.e. who reports to who and who is responsible for what.

- **Planning and Implementation**
  This reflects as to what are the guiding rules, regulations and standards which are in line with the institution/centre. It does also reflect as to what the objectives set-up are and how are they reviewed, prevented, assessed and managed in respect of the risk.

- **Evaluation**
  This is in respect to:
  - How is the institutional/centre performance measured and assessed
  - What are the processes of reporting of accidents and incidents
  - How are investigations of accidents done and managed
  - What are the internal and external audit process are in place to review the system

- **Action for Improvement**
  This is in respect to:
  - How are preventative and corrective actions managed and what processes are in place to ensure the continual improvement process

In summary, are there significant amount of detail within each of these sections which could be examined in detail.

4. Specific Safety Guidelines in Prosthetics and Orthotics Practice

In order to provider the clinicians, practitioners and students, the following specific issues will be addressed:

- Principles of Quality and Safety Guidelines
- General Management of Patients in a Clinical Rehabilitation Team Approach
- Procedures for measurement transfer, bench, static and dynamic alignment
- Adherence to safety measures while working with different tools, equipment's and machines

- **Principles of Quality and Safety Guidelines**

  During the entire period of practice and training of different clinical, practical tasks staff and students are only permitted to embark on a clinical, practical procedure after having been imparted with adequate attitude, knowledge and skills required to assess patients, carry out measurement transfer, produce positive models, work and operate with materials, tools, machines and equipment's.

  The clinicians, practitioners and students who have not been trained are not allowed at all to conduct/assess patients, carry out measurement transfer, translate negative to positive models, bench, static and dynamic alignment, use the workshops unless they have acquired some degree of proficiency as determined by the Clinical or Practical Instructor/Supervisor. In any case all Clinical Staff and Instructors/Lecturers must be formally certified as having qualified after attending an intensive course on quality and safety management course. Such a competence will bring about a higher level of satisfaction. (***Fig-4***).

Fig-4: Optimal Assessment of fit of a Trans-femoral prosthetic client approach

  The institution/prosthetics/orthotics facility will upon satisfaction of acquired the relevant competencies permit in written the staff or student to carry out any clinical practical/procedure without supervision. In most instances, this will be done after a thorough clinical/practical attachment of not less than one-year of a fresh qualified professional or student who have been assessed and confirmed to have attained the relevant competencies without close supervision.

  This Policy on Safety on Quality and Clinical/Facility has been written not only to provide guidelines with appropriate quality management skills or safety procedures but also to assist students/staff with the provision of a reference document outlining the general principles of quality management and safe working practices relevant to the clinical and mechanical engineering aspects of the workshop environment. It relates to specific areas where definite quality and safety measures are required for clinical and workshop operations.

This policy is written as an addition to and not as a substitute for general safety principles applicable to all types of clinical and workshop practice workplace visa vie infections of diseases preventions, fire precautions, correct use of personal protective equipment, hygiene standards, toxic processes, workplace noise and correct manual handling techniques. Information on these areas of quality and safety is given in theoretical/practical lectures/demonstrations pertaining to General Health Education and Workshop Practice Quality and Safety Workplace Site Information Posters and different theoretical and practical demonstrations.

5. Core Criteria for Establishing Quality & Safety Guidelines

The Table below highlights the criteria's in ways that allow for easy and quick references in implementing institutional/centre guideline in ensuring that, it is adhered, effective and long-term sustainable.

CRITERIA	ELABORATION
1. Policy Statement	The institutions/centre aims, objectives and purpose should be spelt out
2. Quality Management Systems	Identify process and outline procedures that implement quality management in the institution/centre
3. Review Mechanisms	Outline the ways in which the implementation of policies would be monitored
4. Programme Delivery	Outline how learning programme s would be developed, delivered and evaluated
5. Staff/Clinicians Policies	Outline Policies and Procedures for Staff/Clinicians/Practitioners selection, appraisal and development
6. Students Policies	Policies and Procedures for selection of Students are outlined and given guidance and support
7. Assessment Policies	Outline Policies and Procedures for Forms of Assessment that are used and how they are managed
8. Management System and Policies	Indicate the financial, administrative and physical structures and resources of organization, as well as procedures of accountability within the institution/centre

5.1 Organizational Structure

QUALITY MANAGEMENT DEPARTMENT
Overseer **Institutional Policy**
Supervisor **Quality Management Systems**
Monitor **Implementation/Review**
Programme Promotor **Awareness**
Staff/Clinicians **Adherence to Essence of Practice**
Students **Adherence to Essence of Practice**
Evaluator **Implementation of policies**
Resources Management **Availing Resources for the System**

5.2 Clinical Areas:

It should be ensured that:

Fig-5: Students observing an optimal clinical environments with Clinical Instructors and clients

- Clients/patients and students are well informed prior to any procedure on the objective of the clinical sessions
- The examination room should be adequately equipped with:
  - examination coach, chairs, stools, cloth, trolley with measurement tools for different prosthetics and orthotics cases, wall mirror, standing frame, etc.
- Ample space should be available within the examination room to allow demonstration of cases to students and others, (***Fig-5***).
- The examination room should be strictly confidential and that, one patient should be examined at a time to ensure the confidentiality
- Patient data forms should be available and all the information should be registered as per the requirement of each individual case.
- Observation of any signs of illness, temperature, discoloration, disability, etc, should be made and refer the patient to the appropriate member of the rehabilitation team for laboratory test to determine the clinical results before proceeding with physical examination.
- Ensure the extremities are free from any cosmetically dressings before carrying out physical examination, e.g. untrimmed nails, rings, jewelries etc. (***Fig-6***)
- The patients should be advised to have washed his/her extremities before touching the patient
- The Prosthetist/Orthotist should wash his/her hands before and after touching the patient

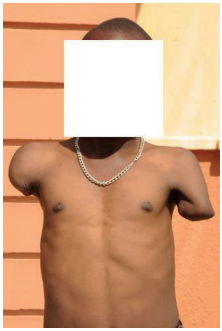


Fig-6: A client ready for physical examination

5.3 Clinical Competencies

The institutional/center's competencies are to continuously develop and apply innovative training and rehabilitation measures and methods to benefit the professionals, trainees and patients/clients. It also works in collaboration with different members of rehabilitation team, i.e. Patients/Clients, Orthopaedic Surgeons, Physiotherapists, Occupational Therapists, Social Workers, Prosthetists/Orthotist, Universities, and Research Departments etc. to ensure high quality of training and service delivery is achieved.

However, it is strictly recommended for students at all times to consult a member of the rehabilitation clinical team during the initial patient/client consultation and examination. The clinical environment must be well prepared with all the required tools, machines and equipment's to carry the relevant test.

5.4 Training – Clinical/Practical Competencies

Clinical/Practical Instruction is the foremost basic instruction which is carried out to ensure that both students and other members of the rehabilitation team are conversant with:

- Clinical team Approach on assessing, evaluating, prescribing and reaching a consensus on the rehabilitation strategies of each patient's/client individual pathology,
- Step by step procedures of achieving an optimum treatment protocol
- Step by step procedure of assessment, measurement transfer, bench, static and dynamic Alignment

5.5 Measurement Transfer (Application of Plaster):

The Clinical Instructor and students must be well dressed including having white clinical coats in the entire period

- Additional clothing for patients, if appropriate should be available in the examination room to be used as will be seen necessary
- The skin should be cleaned and apply dressings to any wounds. If available, apply stockinet to the extremity, avoiding wrinkles. Next, apply a uniform thickness of cotton padding over the stockinet and put extra padding over any bony prominence such as the patella, the elbow or the ankle, (***Fig-7***)

Fig-7: Measurement transfer demonstartion by a Clinical Insgtructor

- Apply either a trollen strap or equivalent or mark the area of which the plaster will be cut during the period of removal
- Soak the plaster roll in a pail containing water at room temperature.
- Do not use warm water as the heat given off by the plaster as it sets may burn the patient.
- Leave the plaster in the water until it is completely soaked and the air bubbles cease to rise.
- Gently pick up the ends of the bandage with both hands and lightly squeeze it, pushing the ends together without twisting or wringing
- While applying the plaster, hold the relevant part of the body steady in the correct position.
- Movement will cause ridges to form on the inside of the plaster. Work rapidly and without interruption, rubbing each layer firmly with the palm so that the plaster forms homogenous mass rather than discrete layers.
- Mould the plaster evenly around the bony prominences and contours and continue moulding the cast until the plaster sets.

5.6 Measurement Transfer (Other Forms):

Any other form or technique of measurement transfer must follow a systematic approach in:

- Ensuring both patient and students are clearly informed of the procedure
- Safe procedures are adhere too and maintained during the entire process of the task
- The procedure quoted beside is well observed

6. Workshop Machines, Equipment's and Tools

6.1 Machinery Installation

The manufacturers of machine tools incorporate various safety features many of which concern the safety of the machine itself. Any of the machinery, plant and equipment must be inspected on delivery to ensure its safety features comply with the requirements of the National and International Health Safety and Welfare and that any other safety features requested on purchase are correctly fitted and indicates the statutory duties of designers, manufacturers and suppliers of machinery in respect of its safe installation and use at the workplace. Each machine must be inspected by a qualified and entrusted Engineer from the Office of the resident engineer prior to commencement of work to ensure that all guards are correctly fitted.

Fig-8: Machines with proper inspection, adequate space and optimal working room

Machinery, plant and equipment must be installed so as to ensure that sufficient space and safe footholds are provided around an individual machine to allow for normal operation, group instruction, adjustment and ordinary repairs, (***Fig-8***).

6.2 Machine Controls

The control of machines should be in accordance with the following requirements:

- Start-stop controls of the push button type easily visible, readily accessible and incorporating both no-volt and overload release.
- Start buttons should be shrouded or recessed, colored green and the word START shall be indicated on or near the button. Starting levers and handles should have a provision for automatic retention in the "off" position.
- Stop buttons shall be long, easy to locate, colored red and clearly marked with an identifying symbol or the word STOP. Each machine shall have a stop control for disconnecting power and the control should be readily and safely accessible to the operator from the normal operating position, See (***Fig-8***) above.
- Emergency stop buttons of the mushroom-head type, prominently and suitably labeled, should be installed at selected positions so that pressing any one of the buttons will immediately operate the circuit breaker and disconnect the supply from the machines.

6.3 Machine Guards

- The use of any power machinery introduces the danger of personal injury due to pinching, cutting, tearing or crushing. This danger can be minimized by the wearing of suitable clothing and fitting suitable guards to protect both the operator and passing traffic. The Guards should be made of unperforated material but designed so as to allow access for inspection and maintenance and should not make the operation of the machine more difficult.
- An obvious function of a machine guard is to keep the operator's body, fingers, clothing and arms away from the danger point without impeding the operation or obstructing vision.
- Another function, which is less obvious, is to prevent a hazardous piece of material from striking the operator e.g. a grinding wheel guard. A suitable guard should not only be shaped to contain the hazard but must also be of sufficient strength to prevent the hazard from being flung out at the operator.
- A guard may serve a further function in preventing the fitting of an unsafe attachment e.g. an oversize wheel to a grinder. This aspect of guard function also applies to interlocks where the machine cannot be started or operated unless the guard is in position

6.4 Service Installations

- Electrical equipment and apparatus to be installed at the centre must have the quality which prevents the danger from shock and fire and should always be maintained in a safe and good condition. The equipment must comply with the relevant requirements of producer and Tanzanian Bureau of Standards.
- All electrical equipment should be checked by a qualified Electrical Engineer from or entrusted by the Office of the Regional Engineer, Kilimanjaro Region, at least once a year and a tag should be affixed to the item indelibly marked with the type of item concerned, the name of the owner of the item, the name of the engineer who carried out the inspection and test and the date on which the inspection and test was carried out.
- All electrical power distribution circuitry should be protected by core-balance earth-Leakage protection of 30mA sensitivity.

6.5 Maintenance

- A programme of regular inspection and maintenance should be in place and carried out on all machines in addition to routine daily surveillance. Cleaning of machines must not be carried out while they are in motion; lubrication and adjustment must be carried out only by the person authorized to do the work.
- The students will be demonstrated on the cleanness of machine, equipment’s and tools by their respective practical instructors.
- Students under the supervision of their Class Instructor will be required to ensure all machines, equipment’s and tools are left clean at the end of each day.
- Students under the supervision of the Class Instructor will carry out a major cleanness of the machines, equipment’s and tools of their respective workshops and classroom on Thursday/Friday at the end of their weekly practical session for at least 30 minutes.

- A thorough maintenance and repair of machines, equipment's and tools will be carried out at the end of the academic year, i.e. mid-July up to end-September each year.

7. General Use

The following part provides general information on the various classes of workshop equipment in general use.

7.1 Hand Tools

- Workshops contain an assortment of hand tools and it is essential that only the correct tools are used for a particular practical task. Improvisation is not allowed if the correct tool is not immediately available. Defective tools must not be used.
- A hand tool should be fitted with a securely fixed handle designed to suit the tool to which it is fitted and the purpose for which the tool is to be used. A place should be provided for. Each tool e.g. toolbox, rack or shadow board, and the tool should be returned to such a place when not in use.
- An edged tool should be kept sharp and ground to the correct cutting angle. Any sharp tool such as a knife or chisel should not be carried in the pocket but should be placed in a scabbard and carried in a toolbox.

7.2 Portable Power Tools

- A powered hand tool should be of the single-purpose type, of robust construction and used only for the purpose for which it was designed. The tool should be placed in a suitable store when not in use and the serviceability at least checked visually for damage to parts and attachments.
- Portable electric power tools should be provided with a non-detachable flexible cable or flexible cord which should be kept as short as practicable to avoid a possible trip hazard and to obviate damage to the cable or cord caused by objects being dropped on it. A suitable plug, preferably an unbreakable type, should be connected to the flexible cable. In addition portable electric power tools and extension leads should be checked periodically by a qualified electrical engineer and the check should include an earth continuity test by a high current testing device.
- Where possible the cable or cord should be run at a high level, dropping down at the working position and not run across the floor. It is recommended that where a 240V portable tool is to be used on a supply system not protected by a core-balance earth leakage protection device each tool should be so protected or double insulated.

7.3 Drilling Machines

- A properly designed drift should be used to remove tapered drills or chucks from the spindle. Fixtures, machine vices or work pieces should be clamped to the table or set against stop bars. Strip material or non-ferrous material should not be drilled unless it is securely clamped or held against a stop.
- When the flutes of a drill become choked with swarf, the machine must be stopped before the swarf is removed.

- Hinged guards should be provided to completely enclose the upper part of the drill spindle, pulleys and belt drives.
- Operators need to be aware of the danger of leaving chuck keys in the chuck after removing or replacing a drill

7.4 Grinding and Polishing Machines

- A grinding or polishing machine is any power-driven machine used for grinding, polishing and buffing of metals by means of an abrasive wheel, scratch-brush wheel or grinding and finishing belt or other similar equipment.
- Every grinding or polishing machine which generates dust must be provided with an efficient exhaust system or dust abatement system. The exhaust system should consist of a hood ducted to an exhaust fan in such a manner as to carry away the dust to a device whereby the dust is separated from the air and is prevented from entering the working room.

Fig-9: Working with optimal gears and probvision of suctions

- All students and staff engaged in grinding or polishing operations must wear suitable eye protection, (**Fig-9**).
- Grinding wheels should be properly mounted and, where necessary, fitted with a bush of suitable material between the wheel and the spindle. So far as practicable and consistent with the nature of the work, a guard of sufficient mechanical strength should enclose the grinding wheel.

- Vibration must be prevented as it may be dangerous, can cause uneven wear and mark the work piece. Vibration can be caused by incorrect wheel balance, lack of rigidity in the machine, loose bearings or incorrect use of the work rest. Where the wheel is belt driven, incorrect fitting of the belt fasteners may be a cause of vibration.
- In pedestal or bench-type grinding machines an eye screen should be provided for handheld work and the area of the screen should be large enough to discourage the operator from looking around it. The screen should always be in place and maintained at an adequate transparency.
- Every grinding wheel should be positioned so that when in use the plane of rotation is not in line with any door, passageway, entrance or a place where someone regularly works.
- Finishing machines should be guarded with only the working face of the belt exposed and the belt should be mounted such that it rotates away from the operator wherever practicable.
- Before use the condition of abrasive belt should be examined and replaced if worn and the correctness of the tracking of the belt should be checked by rotating the belt by hand.

- If necessary the belt should be adjusted and finally checked with a trial run. Where possible suitable jigs or fixtures should be used to hold or locate the work piece; the work piece should never be held in a cloth or any form of pliers and gloves must not be worn when using a finishing machine

7.5 Lathe Machines

- All controls must be in the neutral position before the lathe is started and the isolating switch must be off while adjustments are made to the machine e.g. gear changing, when the machine is not in use, or to remove swarf.
- Chuck jaws, centres and retaining screws should be maintained in good condition and tools, measuring instruments or any other object should not be kept on the moving saddle, lathe bed or head stock.
- Stock bar guards should be provided and kept adjusted so that the bar stock does not project beyond the limits of the guard. The chuck face-plate or other holding device should be effectively guarded where practicable.

7.6 Milling Machines

Students and staff operating milling machines should observe the followings:

- Exercise care when using fast traverse levers in order to avoid running the job into the cutter and never attempt to remove the arbor nut by applying power to the machine.
- Clamp the job or vice firmly on the table before starting the machine, and, where necessary, to provide steady supports to prevent vibration.
- The use of the correct type of handling equipment when heavy cutters are involved and the use of a chip guard when a fly cutter is used
- When an unguarded cutter is in motion, the hands and fingers must be kept well away from the cutters.

7.7 Metal-Cutting Guillotines

Students and staff requires to observe and s apply to the following safe use of metal-cutting guillotines:

- Guards must be provided to prevent the operator's fingers from contacting the knife or clamp from either the front or rear of the machine. Only one person should be allowed to operate the machine at one time and where long material is being cut and cannot be adequately supported by the work table, additional supports should be provided.
- A hand-operated guillotine should be made inoperative when not in use either by removal of the handle or by the use of a locking or similar device.
- The shear edges of the blades should be maintained in good condition and blade clearance must be adjusted in accordance with the manufacturer's recommendation appropriate to the thickness of the material being cut.
- Waste scrap metal provides a hazard for the hands and protective gloves should be worn when the metal is handled. A container should be provided for waste material from the guillotine.

7.8 Power Hacksaws

An automatic knock-off switch should be used at all times and a regular check should be carried out to ensure it is in good order. The work must be secured, adequately supported and the length of any overhang should be clearly indicated to avoid it being a hazard to the student and staff.

7.9 Woodworking Machinery

Woodworking machinery includes circular bench saws, band saws, thicknesses, spindle molders and planning machines. The requirements for woodworking machinery are extensive and are given in Section 9 of Australian Standard AS1485-1983 and Australian Standard AS1473- Code of Practice for the Guarding and Safe Use of Woodworking Machinery.

7.10 Harmful Substances and Processes

- **General Considerations**

  There are several points in relation to chemical safety which are particularly relevant to workshops. These include:

  - Harmful or potentially harmful processes should be carried out using properly designed and well maintained equipment and where practicable in separate areas restricted to a minimum of number of students/staff.
  - Where there is harmful concentrations of fumes or gases develop in certain processes, specific provision should be made for their extraction using local exhaust ventilation in addition to the general ventilation of the workshop;
  - Provision should be made to afford protection against chemical agencies such as harmful dusts, mists, vapors.
  - Chemicals bearing trade names should not be used unless the supplier or manufacturer provides a material safety data sheet giving full information on the precautions which need to be taken when handling the chemical.
  - The possibility of toxic or flammable gases existing or being generated should be indicated by prominently displayed notices.

7.11 Solvent Degreasing

The following solvents are prohibited for use in workshops:

- petrol, kerosene, alcohol, ketones, esters;
- carbon tetrachloride
- Solvent degreasing processes should not be carried out near open flames or electric heaters.
- Spillages should be mopped up with rags or by absorbing in sawdust, dry sand or earth and removing to an open space. Incinerators MUST NOT be used.

7.12 Electroplating and Anodizing

- The floor of any electroplating area should be of impervious material and chemically resistant to the substances used in the electroplating process.
- Tanks must be clearly labeled "POISON" or "CORROSIVE" and show the names of the chemical constituents.
- Special ventilation requirements apply to chromium and cadmium plating baths

- Spray painting and Coating
- All spray painting should be done in a properly constructed and mechanically ventilated booth or in the open air with a 5 meters isolation radius.
- Anyone engaged in or exposed to spray painting of lead paint, silica paint or epoxy resin must wear suitable protective clothing and head covering.

- The following substances are prohibited for use in spray painting operations:
- carbon bisulphate and tetrachloride
- tetrachloroethane
- arsenic or any of its compounds
- any compound containing > 1% benzene or methanol

- The following substances may be used:
- amyl, methyl amyl and n-butyl acetates
- mineral turpentine
- toluene and xylene
- Welding & Cutting

Many materials and coatings give off toxic fumes during welding. These include galvanized iron and compounds of cadmium, lead, zinc and many similar metals. Inhalation of fumes can be avoided if the following precautions are observed:

- Use the least toxic material or process practicable
- Ensure there is adequate ventilation in the form of a movable exhaust hood or if not available then an appropriate respiratory protective device should be used

8, Layout of Work Place

The following should be observed at all times during workshop practice:

- Generally, the workplace should be designed for maximum comfort, convenience, efficiency and safety of the users. The space should be free from unnecessary obstructions and allow free movement of the number of individuals who will occupy it. The space should be properly ventilated with, if necessary, provision for extraction of fumes and collection of dust. An adequate level of lighting should be provided.

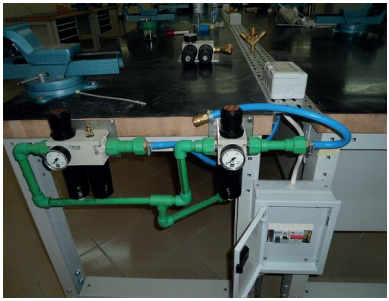


Fig-10: An optimal layoout of a prosthetics and orthotics department

- Workbenches and machines should be positioned with attention to the purposes and frequency of use.

They should consider both efficiency and safety. For example, a machine that is frequently used, such as a bench drill press, should be conveniently placed in relation to workbenches so as to avoid unnecessary movement by the operator, (**Fig-10**).

Similarly, a machine that is potentially dangerous, such as a router, should have adequate space around it, both for the operator and others who may be passing from one part of the workshop to the other.
Workbenches should normally be between about 1.5 and 2 m long and about 0.6 and 0.8 m wide.
To prevent the worker from having his back bent continuously while performing an operation, the height of the working surface should be about 0.9 m. Safety devices, such as electric cut-out switches, should be clearly marked, visible and easily reached. The workshop should be kept clean and tidy, with materials and tools properly stored.

9. Specific Rules to be emphasized:

9.1 Health and Safety at Work

- Hand tools
- The main principles to be observed are that hand tools must be maintained in good condition and used properly for the purpose for which they were designed.
- The correct handles must always be securely fixed on tools such as chisels, files, hammers and planes. Wedges in hammer shafts should always be kept tight.
- Edge tools, such as chisels, planes, etc., should always be kept in good condition, and this includes their frequent grinding and also hardening and tempering.
- The faces of hammer heads should always be kept sound and in good shape.
- Mushrooming on the struck ends of metal working chisels should be removed regularly and not allowed to develop further.
- Sharp tools should be carried carefully and moved about as little as possible.
- Tools should be stored at appropriate height levels. Sharp-edged tools should be kept in racks when not in use.
- Metal bars or other materials being worked on by hand should not be held in the vice or on the bench in such a way that they project into a pathway. Nor should tools be left projecting from a bench.
- Appropriate protective clothing should be used during hazardous operations. For example, goggles (safety glasses) should be worn during chipping operations.

9.2 Machine Tools

- There is a need for a high level of awareness when using machine tools and for the exercise of great care because of the danger of injury. Machine tools should be used in accordance with the manufacturers' instructions and only for the purposes for which they were designed.
- Certain general rules apply to all machine tools:
- Loose clothing that could become entangled with equipment must never be worn.
- Never reach or climb over machinery.
- Before starting, ensure that no one can be injured by the machine when it does start.
- Learn how to stop any machine that you may work on. Keep the floor area around a machine clear and free from obstruction.
- Never use your hands to slow down or stop a machine or shift a driving part whilst in motion.

- Never clean or adjust machinery in motion. You should never operate any machine unless authorized to do so.

- Some machine tools require specific safety precautions. These will be found in this manual adjacent to the description of the machine to which they refer.
- Again, appropriate protective clothing, such as goggles or facemasks, should be worn when operating machines that do not have an integral eye-guard, when grinding plastic materials.

9.3 Workshop Equipment

- All workshop equipment should be kept in good condition, used properly and stored in an appropriate place when not in use.
- Accidents on ladders are very common. Faulty ladders should be taken out of use immediately and repaired or replaced. Always use the proper length of ladder for the job. Make sure steps are fully extended to the full extent of the stays. Never overstretch your reach on a pair of steps or a ladder to a degree that would make them unstable and therefore capsize, or yourself overbalance.
- Electricity is a potential source of accident and should be treated with the respect it deserves. Assume all electric circuits to be live until you are certain they are not. Do not interfere with any electrical apparatus or equipment unless you have the appropriate training or experience. Never switch on a piece of equipment that you do not know how to switch off. Do not use the wrong fuse for the current that the equipment is carrying or use equipment with the earth wire pulled out of its terminal.

9.4 Materials

- Store toxic, flammable, caustic and corrosive materials at low level in suitable containers, cupboards, or store rooms that give necessary protection. Only the quantity required of any caustic, flammable, or corrosive substance should be taken to the workplace at any one time, (***Fig-11***).

Fig-11: A fairely organised store for materials

  - Combustible material should not be stored near any heat source or in strong sun.
  - Know the nature of any material you use. Handle it and store it in an appropriate way.
- Find out the effect of spillage on your skin or splashing in your eye - should you wash with water, use an eye bath, or treat it in a different way? Information is available about all the materials you use. You should find out about them before an accident happens. Remember, the materials you use are safe if handled properly.

9.5 Safety Equipment

- A first-aid box should be available for the treatment of minor cuts, minor burns and abrasions.
- Appropriate equipment should be available for fighting fires, including those of a chemical or electrical nature. You should know the location of all fire alarms and appliances in your work area. You should know how to use all fire appliances correctly. You should know where fire exits are and make sure they are always free from obstruction.
- In general, you should make yourself aware of all the safety equipment available to you and the method of its use. Some of this equipment, such as protective clothing, should be routinely used as required to develop good working practice. Some equipment is there to be used in an emergency or an accident. Familiarize yourself with this equipment - its purpose, its location and the method of use - before an accident happens.

9.6 Protective Measures

When working with different machines, protective measures must be observed and every student and staff member is not allowed to enter to any workshop practice without using either of the following protective gears depending on the task to be done:

- Mask
- Welding Frame/Goggles
- Protective Glasses
- Apron
- Clinical/Working Coat
- Gloves

10. Safety Protection Rule:

10.1 Protection Gears

It must be consider a "**must**" and a basic regulation which must be adhered by any, i.e. Clinician, Practitioner, Instructor or Student when working with any machine that, the following protective gears must be warn at all times, (**Fig-12**):

- Protective mask
- Protective goggles/glasses
- Ear masks
- Apron

Fig-12: Protective Gears

10.2 Placement of Safety Signs on Machines/Equipment's

Fig-13 presents a typical example of placement of signs, protection gears beside a machine or equipment which reminds the user at all times on what is required before starting with operation.

It shoukld also be observed that, some of the machine, e,g, grinding machine has an incooperated protection glass for chips which might harm a user during the operation. However, this does not mean that, you should not use your protective glass.

Fig-13: Sign Machines/Equipments

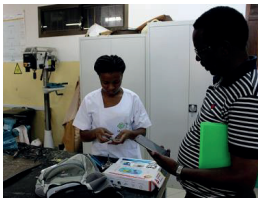


Fig-14: Uniform

10.3 Uniform

Fig-14 presents a good exanple of practice in which one has to be in uniform all the time during the whole period while at the workshop or clinical area.

It should not at all be allowed to have any visitor at the workshop and discuss at the place of work. A separate office or visitors area must be set aside where such discussions and consultations are carried out. Otherwise, a visitor who wants to go through the facility must also be given a uniform and if need be put on the protectikve gears depending on which areas is he/she visiting.

10.4 Dangerous Areas

In a prosthetics and orthotics facility, there are a number of dangerous areas, rooms whereby signs indicating "**danger**" should be placed.

Such items/equipment's could be either where you have main electrical circuit, generator operated by a battery, materials with explosive fumes, etc. Such signs should be placed to be seen vividly and clearly either on the door, machine, equipment or specific site where the item is placed, (**Fig-15**).

Fig-15: Danger Signs

10.5 Fire Areas

Fig-16: Fire Signs, jjj.

There are also areas where one could cause fire in the facility and therefore such sings indicating "**fire alarms**" as well as "**point of operation for alert**" of fire should be placed.

It is common to find these areas also where you have storage of fuels for operations of generators, welding rooms where welded or heated parts could be left without been taken care of their appropriate placement while they are cooling. Areas where there are gas cylinders and nozzles are left loose or the gas pipes are worn out, (**Fig-16**).

10.6 Other Signs

Fig-17: Other Signs

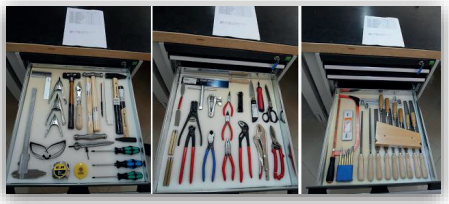
Some other signs among many others which needs to be presented in a prosthetics and orthotics facility are as reflected on (**Fig-17**)

- Reminder/Alarm for the need of using safety/protective gloves
- Observations of smoking habits in all areas of the facility
- Rooms which are not to be entered without prior permission

10.7 Workshop Organization

Among others, one of the exemplary centre which with a well-organized, quality and quality assurance centre was the Prosthetics/Orthotics Workshop in Dar es Salaam at the Comprehensive Community Based Rehabilitation Tanzania, Disability Hospital, Tanzania. The centre has a:

- Well-structured workshop with adequate petitioned working space for each staff/student
- Well secured and protective working environment
- Installation of protected equipment for hazardous materials
- Adequate light for excellent view of the step by step working procedures



Pictures, W. Raab, CCBRT Orthopaedic Workshop, Dar es Salaam, for patient service and place for students of KCMUCo and TATCOT for clinical placement and special practical seminars.

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KCMUCo, Moshi, Tanzania

Tanzania Training Centre for
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