DGAFMS MEMORANDUM NO (165)
ARTIFICIAL LIMBS

Introduction:
1. Although many consider amputation to be the ultimate surgical failure, in actuality, it is a well planned and executed reconstructive procedure. It is aimed at removal of a painful dysfunctional limb (or limb segment) and fashioning of a sensate ‘end organ’ i.e. stump, for fitting of a prosthesis (artificial limb), leading to a functional and pain-free rehabilitative outcome.

2. Amputation not only causes physical disablement but also leads to psychological, social and economic handicap which can be overcome to some extent by provision of an Artificial Limbs. A successful rehabilitation programme for amputees consists of the following stages: -

   Stages of rehabilitation :-
   • Pre-amputation counselling
   • Amputation Surgery
   • Post amputation care
   • Psychotherapy
   • Pre-prosthetic training
   • Prosthetic fitting
   • Training with prosthesis
   • Vocational training
   • Reintegration in community
   • Periodic follow up

Provision of prosthesis or artificial limb is an important and vital step in the overall rehabilitation of the amputee.

History
3. Amputation is one of the oldest problems of the mankind. In 1975 Smithsonian Scientists found a skeletal of a caveman, in Iraq and testified that the caveman had Above Elbow Amputation 45,000 years ago. Therefore it can be said that problem of amputation is as old as the mankind itself. Artificial limb of some kind like a forked-stick must have been in use since the dawn of mankind. Rig Veda mentions of a female warrior, who having lost her foot in a battle was fitted with a prosthetic foot by the celestial twin-physicians. Earliest mention of artificial limb in literature is by Herodotus (484 BC) who described a Persian soldier Hegosistratus using an artificial foot. Artificial limbs were also known to be in use in the medieval Europe. However it was Ambroise Pare who laid the true scientific basis of amputation and prosthesis during the Napoleonic era. Armed conflicts and warfare periodically infused fresh impetus to this science particularly post World War I & World War II. It can be said that Armed Forces throughout the world contributed not only to the increase in amputee population but also in improving their rehabilitation care. In India too, Artificial Limb Centre, Pune is the pioneer in this discipline, working since 1944, an era when concepts of medical rehabilitation was non-existent in the rest of the country.

Definition
4. Prosthesis may be defined as ‘a man made device used to compensate for an anatomical loss’. It may be internal like IOL, Prosthetic Heart Valve, Prosthetic Hip
Joint etc. or external i.e. worn outside the body like Spectacles (for aphakic eye) or a Denture. *An externally applied device to replace a limb or limbs segment is called an artificial limbs (WHO).*

5. Artificial limbs are of two types namely Exoskeletal (Crustacean) and Endoskeletal (modular). In the former the shape as well as the weight transmission is through the walls of the prosthesis and hence has a hard rigid shell. In the later the weight is transmitted through a central shaft, which is covered externally by a cosmetic covering.

**Nomenclature**

6. The nomenclatures of artificial limb are similar to that of the level of amputation. Previously the amputations were named in relation to the major joint in the vicinity (e.g. above knee amputation, below elbow amputation etc). Now a days the level of amputation is named in relation to the major bone through which amputation has taken place (e.g. trans-femoral, trans-tibial, trans-humeral, trans-radial). If an amputation is done through the joint it is called disarticulation (e.g. shoulder disarticulation, knee disarticulation). Consequently the nomenclature of artificial limb have also changed from former to latter i.e. below knee prosthesis is now called transtibial prosthesis and so on. The use of names of individuals are not encouraged with the exception of Syme’s and Chopart’s amputation as they have made a place for themselves due to their uniqueness and popularity. Other amputations, which go by the individual’s names like Gritti-Stroke’s, Boyde’s, Pyrogoff’s etc, are not accepted any longer. Thus the various levels of amputations and their corresponding prostheses are as follows:

**UPPER LIMB**

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<thead>
<tr>
<th>AMPUTATION</th>
<th>PROSTHESIS</th>
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<tr>
<td>Fore Quarters Amputation</td>
<td>Shoulder Disarticulation prosthesis</td>
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<td>Shoulder Disarticulation</td>
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<tr>
<td>Trans-humeral Amputation</td>
<td>Trans-humeral prosthesis</td>
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<tr>
<td>Elbow Disarticulation</td>
<td>Elbow Disarticulation prosthesis</td>
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<tr>
<td>Trans-radial Amputation</td>
<td>Trans-radial prosthesis</td>
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<tr>
<td>Wrist Disarticulation</td>
<td>Wrist Disarticulation prosthesis</td>
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<td>Partially mutilated hand (PMH)</td>
<td>Partially mutilated hand (PMH) prosthesis</td>
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**LOWER LIMB**

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<tr>
<th>AMPUTATION</th>
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<tr>
<td>Hind Quarter Amputation</td>
<td>Hip Disarticulation prosthesis</td>
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<td>Hip Disarticulation</td>
<td>Hip Disarticulation prosthesis</td>
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<tr>
<td>Trans-Femoral Amputation</td>
<td>Trans-Femoral prosthesis</td>
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<td>Knee Disarticulation</td>
<td>Knee Disarticulation prosthesis</td>
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<td>Trans-tibial Amputation</td>
<td>Trans-tibial prosthesis</td>
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<td>Syme’s Amputation</td>
<td>Syme’s prosthesis</td>
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<tr>
<td>Trans-metatarsal(Chopart’s) Amp.</td>
<td>Surgical footwear</td>
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<td>Partially mutilated foot (PMF)</td>
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7. The aim of provision of artificial limb are: -

- Functional and cosmetic,
- Function alone
- Cosmesis alone

Basic function of lower limb is locomotion, which can be easily achieved by provision of prosthesis, whereas the functions of upper limb are fine movement of finger and sensation, which can not be achieved in upper limb prosthesis. Most artificial limb are able to re-instate ‘total body image’ quite satisfactorily. The degree of functional achievement of lower limb prosthesis is dependent upon the level of amputation and the quality of rehabilitative intervention. In case of upper limb prosthesis, though there is satisfactorily total body image compensation, they fall very short of the functional dexterity of the original. An ideal prosthesis should be: -

- Functional
- Comfortable
- Stable
- Cosmetically acceptable
- Inexpensive
- Easily available
- Serviceable
- Preferably Indigenous
- Requiring least maintenance

No prosthesis is comfortable. However a prosthesis that is not uncomfortable is accepted as comfortable. Comfort depends upon two factors namely: -

- Alignment of the prosthesis
- Weight of the prosthesis

A poorly aligned prosthesis will feel heavier and uncomfortable and a properly aligned prosthesis will be comfortable even when heavy.

Upper Limb Prosthesis

8. As mentioned earlier any upper limb prosthesis available today falls far short of the original. They provide very little function and acts just as supportive hand at the best. Therefore they never come up to the expectations of the individual patients. It is for this reason that there is a high rate of rejection or non-use of upper limb prosthesis particularly among unilateral upper limb amputees. Bilateral upper limb amputees however require specialised rehabilitative intervention. The various component of upper limb prosthesis are:- (Fig 1)

- Socket
- Suspension system and harnessing
- Elbow mechanism
- Forearm section
- Wrist unit
- Hand and Terminal Device (TD)

9. **Socket:** It is the part of the prosthesis which accommodates the stump. Being a non-weight bearing prosthesis it may be either soft, firm or rigid. A socket may be made out of leather, plastic or metal. They may be metallic frames, single-walled, double-walled or silicon sleeves.
10. **Suspension system**: It is the mechanism of attaching the artificial limb with the rest of the body. This may be through the shape of the prosthesis, harnessing or suction depending upon the level and type of amputation. Various kinds of suspension systems are bicep / tricep cuff, Munster socket, suction socket, chest strap etc. Harnessing may be figure 8 type, figure 9 type, double-O-type, shoulder saddle type etc.

11. **Elbow Mechanism**: This prosthetic component replaces the anatomical elbow and is a hinge joint which connects the arm and the forearm and can be locked at desirable degrees of flexion as per requirement. It also has a facility of rotation. In human upper limb the rotation takes place at the shoulder joint but in artificial limbs this becomes restricted due to the socket and hence has to be introduced at the elbow mechanism in the form of a turn table. In the forearm side of elbow mechanism facility of supination and pronation can also be provided. The control of the flexion lock is either manually or by ipsilateral shoulder elevation through a cable. Some elbow mechanism has planetary gear to assist flexion. These are used in extremely small stumped trans-radial amputees, where a small degree of natural flexion by the anatomical elbow is magnified in the prosthetic elbow through these gears.

12. **Forearm section**: As the name implies this connects the elbow mechanism with the wrist unit and may be made of leather, plastic or metal and is always made of similar material as the arm section.

13. **Wrist unit**: It is a prosthetic device, which connects the forearm with the hand and may be round or oval. It is used for positioning the hand or terminal device appropriately for optimal function in various degrees of pronation and supination, when not provided in elbow mechanism. They have quick connect or disconnect facility to assist the amputees in changing hand with various terminal devices as per situational demands.

14. **Hand and Terminal Device**: The hand may be passive or functional. Passive hands are of two types i.e. flexible material (rubber or PVC) or rigid material, where the fingers can be placed in required cosmetic position. They only serve cosmetic purpose and has no functional use. The terminal device may be a hook, gripper or a specialised kind. The hand provides a three-jaw chuck while the hook provides a lateral pinch. These may be voluntary opening (VO) or voluntary closing (VC) type. The VO type is more common and easier to use. It opens when a pull is exerted through the cable system and automatically closes when the pull is released. Rubber bands or springs inside the hand mechanism or Terminal Device maintain the closure. The VC type is more physiological but more energy consuming and is not routinely available. Most hands are covered by cosmetic gloves, which are readily available as shelf items. All hands and terminal devices lack sensory feedback and have limited mobility and dexterity.

15. **Control System** :- The control system of upper limb prosthesis are as follows:-
- Body powered
- External powered
- Hybrid.

Body powered control is usually through a ‘cable mechanism’. It is a plastic string housed in a metal cable attached at one end with the hand or Terminal Device and on the other end with the shoulder harness. Tension is exerted through Gleno-
humeral flexion and Biscapular abduction, which moves the hand or terminal device. Poorly adjusted harness decrease the power transmission.

External powered control uses energy from a battery pack. Impulses from a micro-switch or myo-electric sensor activate the motor, which moves the hand or the terminal device.

Hybrid control is the combination of the above two in various combinations and is usually used in Elbow disarticulation or higher amputations to differentially control the movements at the hand, elbow and shoulder respectively.

16. Based upon the component parts, the compositions of prosthesis for various level of upper limb amputation are as follows:

(a) **Shoulder Disarticulation Prosthesis:** It has a double jacketed leather or plastic socket suspended with the help of chest strap suspension. Specialised shoulder joints are also available for endoskeletal prosthesis. The arm portion may be of leather, metal or plastic ending in the elbow mechanism. The forearm portion is similar to the arm portion, ending in the hand. It must be mentioned that most shoulder disarticulation prosthesis are only of cosmetic value and has very little function. It is imperative therefore to keep the weight of this prosthesis to bare minimum by avoiding the prescription of the mechanical elbow wrist unit and the hand. Instead free hinges elbow mechanism and a simple cosmetic glove may be prescribed unless the individual patients demand otherwise depending upon their requirements.

(b) **Trans-humeral Prosthesis:** The trans-humeral prosthesis has a socket made of leather or plastic usually extending above the shoulder joint for anchorage. Figure of 8 suspension system through the opposite axilla, lockable elbow mechanism, forearm section similar to arm section/socket, wrist unit and hand/terminal device are prescribed. Unilateral amputees usually use these prostheses only as a supporting limb. In case of use only for cosmesis (show hand) the weight may be reduced in a manner as described above in (a).

(c) **Elbow Disarticulation Prosthesis:** The socket is usually of moulded leather as the terminal end of stump is bulky. Figure of 8 suspension, external hinge elbow joint of the two sides of the socket, forearm section ending in wrist mechanism and prosthetic hand are prescribed.

(d) **Trans-radial Prosthesis:** The socket may be leather or plastic usually ending in wrist unit and hand substitute. In case of non-functional cosmetic prosthesis the cosmetic gloves are directly mounted on the distal end of the socket making it absolutely lightweight.

(e) **PMH Prosthesis:** These are usually rigid, hollow and are made of plastic or ‘Certalmid’ (laminated fabric with resin). They are usually passive and provide body image restoration but many a time interferes with residual function and sensation of the remaining part of the hand.

17. **Ideal time for Upper Limb Prosthesis:** The prosthesis in upper limb single amputees should be provided as early as possible. It has been observed that unilateral amputees invariably develop unilateral functionality within a very short duration. Any functional upper limb prosthesis should be provided within four weeks of amputation beyond which it is unlikely to be used for any functional purposes by the amputee. Presence of suture, oedema or wound on the stump is not the contraindication for
measurement taking or prosthesis fitting. As and when the stump oedema subsides and shrinks the prosthetic socket may be modified. It is advisable therefore to use leather socket in the initial prosthesis, which can be modified with relative ease.

**Lower Limb Prosthesis**

18. The primary function of lower limb prosthesis is weight bearing and to assist in ambulation. The degree of functional independence and ease is directly proportional to the level of amputation i.e. more distal the amputation more satisfactory is the functional achievement of the prosthesis. The various component of lower limb prosthesis are: - (Fig 2)

- Socket
- Suspension system
- Knee mechanism
- Shank or shin section
- Ankle and Foot

19. **Socket: -** It is the part of the prosthesis which comes in contact with the stump and has to be custom made as per dimensions of the stump. Being a weight bearing prosthesis the socket needs to be rigid and tough. However flexible but strategically reinforced lower limb sockets are also available now a days. In **Hip disarticulation prosthesis** a bucket shaped socket moulded out of either leather or plastic is used, which accommodates the remaining part of the hip. In **trans-femoral prosthesis** various kinds of sockets are available namely plug-fit, quadrilateral, ischial containment [NSNA (normal shape normal alignment), CATCAM (contoured adductor trochanteric controlled alignment mechanism), Narrow ML (medial-lateral)] etc. In **trans-tibial prosthesis** the most commonly available socket is the PTB (Patellar Tendon Bearing) socket. The older thigh corset type of prosthesis (conventional below knee prosthesis) is not made routinely except for very old amputees who are used to using this type of limbs. In some cases the antero-medial and antero-lateral margins of a PTB socket is extended proximally above the femoral condylar margins to make them self-suspending and also gain medio-lateral stability. This type of socket is called is called PTS (Patellar Tendon Supracondylar or Prosthesis Tibialis Supracondylaris) socket. Some authorities prefer calling the PTB/PTS as TSB (Total Surface Bearing) socket on the ground that the body weight of the amputee is transmitted throughout the socket and not only through the patellar tendon alone. They also argue in favour of TSB on the ground that the so-called patellar ‘tendon’ is a ligament and not a tendon at the first place! Most **Syme’s** amputees also use PTB socket for partial weight relief from the terminal end of the stump. Few Syme’s amputees however prefer using an conventional leather socket in modified Syme’s prosthesis. The sockets for Chopart’s or further distal amputations are usually made of leather with distal foot build-ups.

20. **Suspension System: -** It is the mechanism of attaching the prosthesis to the body and may be either suction type or non-suction type. The latter may be belt and buckle type [Metallic hip joint with pelvic band and waist belt, Silecian band or a TES (total elastic suspension)]. The former has a suction valve incorporated in the total contact prosthetic socket, which produces a negative pressure and holds the prosthesis with the body. Nowadays silicon suction sockets are also available.

21. **Knee Mechanism: -** Replicating the human knee is the most difficult engineering challenges in the science of prosthetics. It is a weight-bearing joint with inherent stability in various degrees of flexion. The art of duplicating the knee has yet
not been perfected and hence there is a multitude of designs available in the market with their own merits and demerits. These are free knee, constant friction knee, variable friction knee, weight-activated stance phase controlled knee, swing-phase controlled unit (mechanical, hydraulic or pneumatic), polycentric (Four-bar or Six-bar) knee and computer controlled knee.

22. **Shin / Shank:** Depending upon whether the Endo or Exo-skeletal system is used the shin part or the shank may be made of wood, plastic, metal or composites.

23. **Ankle and Foot:** The prosthetic feet are classified as per the movements available at the ankle. They are SACH (solid ankle cushioned heel), mono-axial, multi-axial and energy storing types. Cosmetic coverings are also available allowing bare-foot activity if desired.

24. Based upon the component parts, the compositions of prostheses for various level of lower limb amputation are as follows:

(a) **Hip Disarticulation Prosthesis:** A leather or plastic bucket shaped socket is moulded. A traditional lockable hip joint may be fitted in the inferior surface, which extends on the lateral side but it is no longer in vogue. The usual joint used at present is a Tilting Table (TT), which is fitted to the antero-inferior surface of the socket with the fulcrum, placed anteriorly thus simulating hip flexion. Similar endo-skeletal prosthetic joints are also available. The TT hip joint is a free joint whose stability is maintained by proper alignment of the prosthesis. All hip disarticulation prosthesis also has a knee joint incorporated though most amputees prefer walking with a locked knee. Shin and foot are as described in the componentry earlier.

(b) **Trans Femoral Prosthesis:** Socket is made of either wood (manual or machine carving) or moulded plastic and very rarely with leather. The knee mechanism is attached at the inferior end, choice of which is dependent upon the need, profession, age, and financial capabilities of the individual patient. The most popular indigenous knee mechanism in our country for the average disabled is the hand operated mechanical knee lock in a constant friction knee joint. However in developed countries the weight activated stabilised knee is most popular. The shin block is made of wood, plastic or metal depending upon a type of prosthesis i.e. endo or exo-skeletal. The most preferred foot is SACH.

(c) **Knee disarticulation prosthesis:** It is similar to trans-femoral prosthesis except the socket is usually of moulded leather to accommodate the bulkiness of the terminal part of the stump. It provides anchorage at the supra condylar level. Leather laces or velcro strapping may be provided thus making it self suspension type. Being a weight-bearing stump, quadrilateral ischial weight bearing socket is not a necessity. Knee joint may be of external type or nowadays endoskeletal knee of four-bar type is also used. However the femoral part of the prosthesis tends to be longer and bulkier than their contralateral counter part and causes cosmetic problems.

(d) **Trans-tibial prosthesis:** The socket is usually of the PTB variety. The most preferred material is the epoxy or polyesterine resin. The shin is of the same material as the socket in exoskeletal prosthesis and metallic or composite in endoskeletal prosthesis. The most preferred foot is the SACH.

(e) **Syme’s prosthesis:** Usually these are exactly similar to a trans-tibial exoskeletal prosthesis with an elongated socket. Some amputees however prefer leather socket with opening at the back. Now a days extremely light weight, highly responsive Syme’s prosthesis are available, which are made of high resilience carbon fibre which offers great strength, durability and energy returning capability at the foot. These have flexible keel with thick layer of polyurethane for maximum inversion/eversion and ideal to meet the needs of Symes amputees of all activity levels.
(f) **Chopart’s and partially mutilated foot prosthesis**: These are usually leather socket with foot build-ups with customised surgical footwear to provide horizontal weight bearing surface and satisfactory ‘foot roll’ during ambulation.

### Recent advances

25. Recent advances in the field of prosthesis have been phenomenal, particularly in material sciences, measurement techniques, manufacturing methods and use of electronics. Natural material like wood, metal, leather though bio-friendly, are being replaced by various man made material like epoxy and polyester resins, polymers like High density Poly- Ethelene (HDPE), High density Poly- proplene (HDPP), Poly Urathane (PU), Poly Tetra-Fluro Ethylene (PTFE, also called Teflon) and silicon. Reinforced material like glass and carbon fibres have increased strength and decreased weight of the prosthesis. The measurement techniques and also changed from man-centred to machine-centre type. Pressure casting and electronic scanning of stump may reduce the time period and increase the exactness of the socket fitment. Computerisation has helped in data storage, on screen modification, CADCAM (Computer Assisted Designing Computer Assisted Manufacturing), digital lathe machine usage etc. Thus measurement can be taken at one place and then be transmitted to the prosthesis-manufacturing unit, where the component parts are fabricated and sent for fitting at the place where the patient resides. Reduction of time frame for manufacturing and fitting reduces over all hospitalisation and associated expenditure.

26. Two computerised control systems in prosthesis have been topics of interest in recent time. These are myo-electric prosthesis for upper limb amputees and cadence control knee mechanism for lower limb amputees. Both of these require clarification.

27. **Myo-electric prosthesis** use external power from a battery source. The hand movements are controlled by the electrical signals generated at neuro-muscular junction of forearm flexors and extensor. The signals are picked up by sensors located inside the socket at the area of maximum electrical activity. The signals activate a motor fitted in the hand/wrist unit, which moves the fingers of the prosthetic hand. In other words when amputee thinks and makes an efforts to open the fingers the electrical impulse generated at the neuro-muscular junction of the extensor activate the motor to open the fingers. Similar activity also takes places for closures of the fingers when the person thinks and flexor group of muscle gets activated. Since the process is thought accentuated the prosthesis is also called **bionic prosthesis**. In amputation above elbow joint the micro switch operated prosthesis are available, which control the movement at elbow, wrist and fingers by movement of the stump inside the socket.

28. The **Cadence Control prosthesis** has a specialised knee unit, which is controlled through microchips and can be pre-set at five or more speeds. The sensors in the prosthesis can judge the gait and speed of the contra-lateral limb and automatically adjust the prosthetic knee in that speed range. Both myo-electric and cadence controlled prosthesis are cost prohibitive and do not necessarily compensate the functional advantage that these prosthesis give over their conventional counterpart.

### Special Considerations

29. **Congenital Limb Deficiency**: This group of patients offer a special challenge as every patient has his own kind of deformity, associated problems and requirements.
Surgical intervention may be necessary in a few cases for successful prosthetic fitting. The congenital lower limb amputee should be provided with the prosthesis at the age when the child would have normally started standing i.e. approx 12 months of age. The congenital upper limb amputee should be provided with the prosthesis as early as possible. At this stage the prosthesis should be of soft material to avoid any injury. The child uses it like a toy initially and slowly grows with it. Definitive prosthesis should be provided at school going age.

30. **Paediatric amputees**: - This group of amputees need frequent change of the prosthesis due to the rapid growth. Prosthetic principles remain similar to that of the congenital limb deficient cases. Psychological needs, not only for the patient but also the parents, require special attention. This is particularly acute during school going age and during adolescence.

**Ideal Stump**

31. Some kind of prosthesis can be made for any kind of stump but perfect prosthetic fitting a perfect amputation stump is necessary. The characteristics of an ideal stump are: -

(a) **Length** - In hip disarticulation amputation it is advisable to keep the head and neck of the femur so as to provide a horizontal weight-bearing surface. In trans-femoral amputation, the stump should be as long as possible however a clearance of 10 cm from knee joint line helps in fitting the knee mechanism in the prosthesis. A minimum length of 8-cm (3 inch) from crotch line is required for prosthesis fitting otherwise stump slips out of the socket during flexion. In trans-tibial amputation the length should be 22-27 cm (9-11 inch) in traumatic and 12-18 cm (5-7 inch) in dysvascular aetiology. Importance of preservation knee at all cost cannot be over emphasised as the knee retains the proprioceptive sensation and thus amputee is able to sense the positioning of the foot even in darkness. In Syme’s amputation a 6-cm (2.5-inch) ground clearance is required for fitting of the prosthesis foot otherwise the contralateral limb becomes shorter and will require height compensation. In Chopart’s amputation and other further distal amputation sole skin should be retained if normal sole skin is not available the stump will fail to bear the body weight and will have frequent break down. In such conditions a higher amputation should be considered. In shoulder disarticulations the head and neck of the humerus should be retained to provide a horizontal support for the prosthetic fitting. In trans-humeral amputation the length of the stump should be as long as possible however 8 cm clearance from elbow joint line is required for fitting of prosthesis elbow. In trans-radial amputation the length should be atleast 3 cms from the crease – line at the cubital fossa when the elbow is flexed. This is required to provide purchase of the prosthetic socket. A 5 cm clearance from the wrist is required for fitting the wrist unit. An ideal length in trans-radial amputation is 12-15 cm from the cubital crease.

(b) **Suture line or scar**: - The scar should be supple and non-tender. It should not be on a high-pressure zones i.e. an area subjected to excessive friction or sheer force. Scar adherent to subcutaneous tissue, neuromas, bone usually causes ulceration and pain.

(c) **Range of motion (ROM)**: - The range of motion of the proximal joints to the stump should be full and free of pain for optimal use of the prosthesis.
(d) **Musculature around the stump:** The stump should be well padded. Antagonistic muscles should be sutured together to maintain normal muscle tone.

(e) **Skin over the stump:** Healthy sensate skin is essential to withstand the extra load associated with prosthetic fitting. It can also give a positional feedback of the prosthesis.

(f) **Tip of the bone:** It should be smooth particularly the tibial tip should be bevelled and smoothened with a rasp or a file.

32. **Post-prosthetic training** is important part of the rehabilitation. Proper gait training with visual biofeedback is essential to achieve pre-morbid gait pattern. Donning and doffing of prosthesis, maintenance of prosthesis and its components forms part and parcel of the prosthesis training. Pre-amputation, pre-fitting counselling and support system by other amputees go a long way in achieving the rehabilitation goal.

33. The science of prosthesis has travelled a long way since the pre-historic ‘forked stick’ and has a bright future ahead. All the mechanisation and sophistication in the science should not steal away the basic fact that the patient is the centre of our entire endeavour and the ‘human element’ of prosthetic rehabilitation should never be forgotten.

### Entitlement of treatment at ALC Pune

1. **Serving Military Personnel**
   
   **Auth:**
   
   - Govt of India Min of Def letter DGAFMS/DG-3A/2781/D(Med) dt 02 Jun 67
   - Govt of India Min of Def letter No. 43769/DGAFMS/DG-1C/541/D(Med) dt 04 Mar 97

   **Initial Entitlement:** Entitled to free prosthesis- Appx III of DSR (RMS) 1983

   **Procedure of transfer** – The patient can be transferred directly from peripheral hospitals to ALC without routing the case through zonal or command hospitals. **Issue of second set of prosthesis** is at the discretion of the Commandant ALC, Pune 411040.

   **Replacement or Repair** of the prosthesis is entitled free.

2. **Dependant of Serving Military Personnel**

   **Auth:** Govt of India Min of Def letter No DGAFMS/DG-3A/1712-S/D Med dt 18 Dec 1980

   **Initial Entitlement:** Entitled free prosthesis

   **Procedure of transfer** – The patient cannot be transferred. They are to report with fresh dependency certificate issued by the unit authorities as per AO 120/80 and AO 16/91 (Specimen copy as per Appendix A to this publication)

   **Replacement or Repair** of the prosthesis is entitled free.
3. **Ex Servicemen** –
   (a) **When amputation has occurred during his service period** – Entitled for free prosthesis. **Auth**: Appx III DSR(RMS) 1983.

   (b) **When amputation has occurred after retirement.**

   (i) If the amputation is due to a disease process contacted during service, which was either attributable to or aggravated by Mil service – the patient is entitled for free prosthesis.

   **Procedure of transfer** – The patient can be transferred directly from peripheral hospitals (nearest services hospital) to and from ALC on Govt expenditure.

   (ii) If the amputation is due to a disease process contacted after service and is neither attributable to nor aggravated by Mil service – the patient is not entitled for free prosthesis. However provision exist for providing free prosthesis through welfare funds at the disposal of Commandant ALC. This is subject to availability of the fund. These patients are not entitled transfer to and from ALC on Govt expenditure.

4. **Dependants of Ex-servicemen** are not entitled to free prosthesis.

5. **All other categories** of patient will be treated as non-entitled cases and may be provided with prosthesis on payment as per Govt rates. All such cases should apply to Commandant Artificial Limb Centre, Pune 411040 and will be entertained only on prior appointment.

6. **Bed availability**: - All male patients including dependants of PBOR will be hospitalised at ALC Pune. Prior bed availability need not be taken. Officers, Officer’s families, PBOR’s families and dependants who are of the paediatric age group will be admitted after taking prior bed availability at Command Hospital (Southern Command), Pune.

**Note**

1. NCC Officers are not entitled for free issue of prosthesis (Auth: DGAFMS Min of Def letter No. 6016/DGAFMS/DG-1C dated 21 Aug 1985), Hence their families will also be non entitled.
2. 22 Establishment personnel-same as Mil personnel Auth Govt of India cabinet Secretariat (Emergency affairs II cell) letter No EA/FF- Meh 3/67 dt 18 Jun 1968.
5. GREF Personnel: Entitled only if they are under operational control of COAS during National Emergency. **Auth : Govt of India Min of Def letter No. 70630/DGBR/ETA(TLC)/4682/Med dated 24 Oct 1973.**
6. Foreign Nation See note 1, &2 or page 19 and not 3 on page 20 of book let (To be copied here).
7. Cadets AFMC, NDA, IMA and Nursing Cadets, and recruits (before oath ceremony) are not entitled free issue of prosthesis
8. As note 1 on page 34.
9. As Note 2 on page 24
10. HSR. As per DSR RMS
11. Subsistence allowance to entitled cases as auth.