AMPUTATION


WAIT A SEC! ARE YOU SURE THIS WILL BE GOOD FOR ME?
QUIT WHINING! IT'S NOT ALL ABOUT YOU, YOU KNOW.
THIS WILL HURT OBAMA MORE THAN IT HURTS YOU. WE HOPE.
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NATIONAL SECURITY
START TREATY
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11/22/10

History

- *Amputatio* - Latin noun from verb *Amputare*
- *Amputare* - to cut off or cut away, derived from
  - *Amb*, about and
  - *Putare*, to prune or to lop
- The verb "*Amputare*" was employed to cutting off the hands of criminals.

History cont…

- Early 15th centur *The Cyrurgie of Guy de Chauliac* has a paragraph headed *"The rewle in kyttyng of a dede membre"* (The rule in cutting off of a dead member)
- Ambroise Pare,1564, Father of French surgery, Improved ligation of larger vessels during surgery, gangrene
- Lowe, 1612, English, extirpation

History cont…

- Woodall, 1617, Dismembering or Amputation
- Woodall, 1639, Employed both amputation & dismembering, the former as often.
- Dionis, 1750, suggested employing the Greek word *Acrotiriasmos* – cutting off the extremities of the body.
- 17th century British authors Cooke & Wiseman employed *"Amputation"*

Definition

- Amputation is the removal of limb, part or total from the body.
- Disarticulation is removing the limb through a joint.
- Generally the amputation of Lower Limb are more common than those of upper limb.

Incidence

- Age -
  - Common in 50 - 70 year
- Gender -
  - Male - 75%
  - Female - 25%
- Limbs -
  - Lower limbs 85%
  - Upper limbs - 15%

Indications of Amputation

- Trauma – RTA, Gun shot
- Malignant tumors
- Nerve injuries & infection
- Extreme heat & cold – burn, gangrene
- Peripheral vascular insufficiency
- Congenital absence of limbs or malformation
- Severe infection

Causes of Amputation

- Natural causes
- Accidental causes
- Ritual, Punitive & Legal Amputations
- Cold steel & Gunshot causes

Natural causes of limb loss

- Congenital absence
- Arterial disease
- Frostbite
- Ergot and other toxins
- Wound infections
- Diabetes mellitus
- Dietary deficiencies
- Tumors

Accidents causes

- Falls when running or from heights
- Crushing by trees
- Savaging by crocodiles and sharks
- Effects of earthquakes, tsunamis and Violent storms

Ritual, Punitive & Legal Amputations

- Curing local pain
- In removing deformity
- Infection or gangrene
- In saving lives

Cold steel & Gunshot causes

- Iron & steel weapons evolved fingers & hands
- Destructive gunshot wounding, associated with mortal sepsis
- Boiling oil

Relative % of causes of LL amputation

Developed world causes	(%)	Developing world causes	(%)
PVD (approx. 25-50% diabetes mellitus)	85-90	Trauma	55-95
Trauma	9	Disease	10-35
Tumour	4	Tumour	5
Congenital deficiency	3	Congenital deficiency	4
Infection	1	Infection	11-35

Relative % of causes of UL amputation

Developed world causes	(%)	Developing world causes	(%)
Trauma	29	Trauma	86
Disease	30	Disease	6
Congenital deficiency	15	Congenital deficiency	6
Tumour	26	Tumour	1

Types of amputation

- Closed Amputation
- Open Amputation (Guillotine Operation)

Closed Amputation

- It is done as an elective procedure.
- After amputations, the soft tissues are closed primarily over the bony stump.
  - E.g., above knee, below knee etc.

Open Amputation (Guillotine Operation)

- It is done as an emergency procedure.
  - E.g. life threatening infections
- After amputations, the wound is left open & not closed.
- 2 types depending upon the skin flaps:
  - Open amputation with inverted skin flap
  - Circular open amputation

Principles of Close Amputation

- Tourniquets: desirable except in ischemic limbs.
- Level of amputation: it is very important to fit the prosthesis.
- Skin flaps: good skin coverage is important. Skin should be mobile & sensitive.
- Muscle: is divided at least 5cm distal to the level of intended bone section & sutured.

Principles of Close Amputation cont…

- Methods of Muscle Suture
  - Myodesis - muscle is suture to bone
  - Myoplasty - muscle is sutured to opposite muscle group under appropriate tension.

Principles of Close Amputation cont…

- Nerves: cut proximally & allowed to retract. Large nerves are ligated before division.
- Blood vessels: doubly ligated & cut. Then the tourniquet is released & hemostasis is completed.
- Bone: section above level of muscle section.
- Drains: removed after 48 - 72 hours.

Principles of Close Amputation cont...

- Compression dressing: Either elastic or a rigid plaster dressing fitting immediately.
- Absolute bed rest with limb elevation: This is acceptable for the conventional prosthesis with adequate vascularity.
- Limb fitted: Conventional prosthesis is fitted a minimum of 8 - 12 weeks after surgery. Rigid dressing with temporary pylon prosthesis may be elected as an alternative.

Principle of open amputation

- Indication:
  - Severe infection
  - Severe crush injuries
- Types:
  - Open amputation with inverted skin flaps: it is a common choice.
  - Circular open amputation: wound is kept open & closed 2* by suture, skin graft or re-amputation.

Principle of open amputation cont...

- Rx following amputation:
  - Rigid dressing concept (Pylon): POP cast is applied to the stump over the dressing after surgery.
  - Soft dressing concept: The stump is dressed with the sterile dressing & elastocrepe bandage applied over it.

Complication of amputation

- Haematomas
- Infections
- Necrosis
- Contractures
- Neuromas
- Stump pain
- Phantom sensation
- Hyperesthesia of stump
- Stump edema
- Bone overgrowth
- Causalgia

Amputation - Complications

- Phantom Limbs –
  - Some amputees experience the phenomenon of *Phantom Limbs*; they feel body parts that are no longer there.
  - Limbs can itch, ache, & feel as if they are moving.
  - Scientists believe it has to do with neural map that sends information to the brain about limbs regardless of their existence.

Amputation – Complications cont....

- In many cases, the phantom limb aids in adaptation to a prosthesis, as it permits the person to experience proprioception of the prosthetic limb.

Amputation – Complications cont…

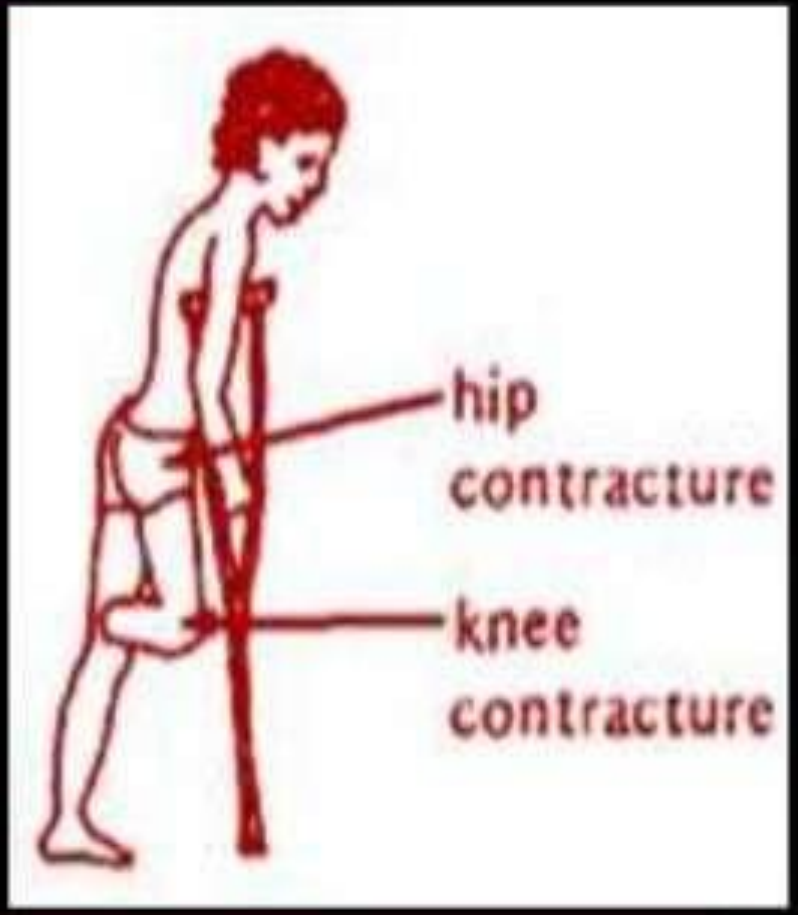
- Painful adhesive scar formation
  - An adherent painful scar over the surgical incision poses a problem in process of rehab.
  - It may obstacle in fitting prosthesis.
  - Early mobilization of the painful scar is recommended with other therapeutic modalities.

Amputation – Complications cont...

- New bone formation at the amputation sites
  - It has been reported that new bone formation 5 weeks after electrical burn.
  - The stump should be closely watch for any sing & symptoms like - tenderness, warmth & swelling *(Helm & Walker, 1987)*
  - Such symptoms delayed fitting final prosthesis.

Amputation – Complications cont…

- Flexion Deformity
  - Deformity complicates the process of prosthetic fitting & ambulation.



Amputation – Complications cont…

- Hyperesthesia of the stump:
  - This is another annoying symptom that is difficult to control.
  - Re-amputation results only in reproducing the symptom at a higher level.

Reasons for amputation

- Circulatory disorders
  - Diabetic foot infection or gangrene (the most common reason for non-traumatic amputation)
  - Sepsis with peripheral necrosis

Reasons for amputation cont…

- **Neoplasm**
  - Cancerous bone or soft tissue tumors
    - e.g. osteosarcoma, osteochondroma, fibrosarcoma, epithelioid sarcoma, ewing's sarcoma, synovial sarcoma, sacrococcygeal teratoma
  - Melanoma

Reasons for amputation cont…

- Trauma
  - Severe limb injuries in which the limb cannot be spared or attempts to spare the limb have failed
  - Traumatic amputation (Amputation occurs usually at scene of accident, where the limb is partially or wholly severed).
  - Amputation in utero (Amniotic band)

Reasons for amputation cont…

- **Infection**
  - Bone infection (osteomyelitis)

Reasons for amputation cont…

- As a punishment in Islam
  - According to Islamic Sharia Law, the punishment for stealing is the amputation of the hand & after repeated offense, the foot (Quran 5:38)
  - This controversial practice is still in practice today in countries like Iran, Saudi Arabia & Northern Nigeria.

Reasons for amputation cont…

- Other
  - Sometimes professional athletes may choose to have digit amputated to relieve chronic pain & impaired performance.
  - Australian footballer Daniel Chick elected to have his left ring finger amputated as chronic pain & injury was limiting his performance.
  - Rugby player Jone Tawake also had a finger removed.

Amputation Level Nomenclature	
Old Terminology	Current Terminology
Partial hand	Partial hand
Wrist disarticulation	Wrist disarticulation
Below elbow	Transradial
Elbow disarticulation	Elbow disarticulation
Above elbow	Transhumeral
Shoulder disarticulation	Shoulder disarticulation
Forequarter	Forequarter
Partial foot	Partial foot
Syme's	Ankle disarticulation
Below knee	Transtibial
Knee disarticulation	Knee disarticulation
Above knee	Transfemoral
Hip disarticulation	Hip disarticulation

Levels of Amputation

Partial toe	Excision of any part of one or more toes
Toe disarticulation	Disarticulation at the MTP joint
Partial foot/ ray resection	Resection of 3rd-5th metatarsal & digit
Transmetatarsal	Amputation through the midsection of all metatarsals
Syme's	Ankle disarticulation with attachment of heel pad to distal of tibia
Long transtibial (Below knee)	More than 50% tibial length
Short transtibial (Below Knee)	Between 20% and 50% of tibial length
Knee disarticulation	Through knee joint
Long transfemoral (Above knee)	More than 60% femoral length
Transfemoral (above knee)	Between 35% and 60% femoral length
Short transfemoral (Above Knee)	Less than 35% femoral length
Hip disarticulation	Amputation through hip joint, pelvis intact
Hemipelvectomy	Resection of lower half of the pelvis

Level of Amputation (%)

Level	Developing world	Developing world
❖ Lower limb –		
❑ Trans-tibial (including foot)	29-62	49-71
❑ Trans-femoral (including knee disarticulation)	33-49	26-40
❖ Upper limb –		
❑ Trans-radial (including wrist disarticulation)	32-66	21-33
❑ Trans-humeral (including elbow disarticulation)	14-26	25-36

Principle consideration to amputate

- Preservation of life
- Improvement of general health
- Restoration of function
- Reduction of pain

Clinical Team Members & Function (O'Sullivan, 1994)	
Physician	Clinic chief; coordinates team decision making; supervises client's general medical condition; prescribes appliances.
Physical therapist	Evaluates & treats clients through pre & prosthetic phases; makes recommendations for prosthetic components & whether or not to fit client. May be clinic coordinator
Prosthetist	Fabricates and modifies prosthesis; recommends prosthetic components; shares data on new prosthetic developments
Occupational therapist	Assesses & treats individuals with UL amputations; makes recommendations for components.
Social worker	Financial counselor & coordinator; provides liaison with third-party payers & community agencies; helps family cope with social and financial problems.
Dietitian	Consultant for diabetes or those needing diet guidance.
Vocational	Assesses clients employment potential; coordinates and may

Rehabilitation of LL Amputation

- Pre operative period
- Post operative period
  - Pre-prosthetic stage
  - Prosthetic stage

PRE - OPERATIVE PERIOD

Pre Operative period

- Assessment
  - Physical
  - Social
  - Psychological
- Training
- Re-assurance

Pre Operative Assessment

- Assessment of -
  - The affected limb
  - The unaffected limb &
  - The patient as a whole is conducted thoroughly.
- Assessment of physical, social & psychological status of the patient should be made.

Physical Assessment

- Muscle strength of UL, trunk & LL apart from the affected limb before level of amputation.
- Joint mobility, particularly proximal to the amputation level.
- Respiratory function
- Balance reaction in sitting & standing
- Functional ability
- Vision & hearing status

Social assessment includes

- Family & friends supports
- Living accommodation –
  - Stairs, ramps, rails, width of door, wheelchair accessibility
- Proximity of shops

Psychological Assessment

- Patients psychological approach to amputation.
- Motivation to walk.
- Other psychological problems.

PRE OPERATIVE TRAINING

Basic aims

- To prevent post operative complication
- To reduce the cost of rehabilitation
- To reduce the period of rehabilitation

Training program includes

- To prevention of thrombosis:
  - Maintaining circulation through movt of the other good limb.
- To prevent the chest complication:
  - Deep breathing, coughing & postural drainage
- To relieve pressure:
  - Pressure mobility of all the joints
  - More emphasis is given to susceptible joints.

Training program cont…

- To improve mobility:
  - Mobility ex for trunk, pelvic or shoulder girdle
  - Mobility ex to compensate for the deficiencies & restriction due to prosthesis.
  - Teach the technique to be adapted for mobility & limb positioning in bed.

Training program cont...

- To educate the patient:
  - Educate the techniques of transfers, monitoring wheelchair, single limb standing & balancing.
  - Explain important aspect of balance, equilibrium, standing & walking techniques.
  - Educate to detect the possible complications like - *soft tissue tightness, pressure point, expected degree of pain & phantom pain.*

Reassurance

- Psychological reassurance play an important roll in recovery
- Reassurance with all possible encouragement
- Practical demonstration by who has undergone similar surgery.

POST OPERATIVE PERIOD

(PRE PROSTHETIC STAGE)

Aims of Rx

- To prevent post operative complication
- To prevent deformities
- To control stump edema
- To maintain strength of whole body & increase strength of muscle controlling the stump
- To maintain general mobility
- To improve balance & transfer
- To re-educate walking
- To restore functional independence
- To treat phantom pain

Prevention of post operative complication

- Breathing ex to prevent respiratory complications.
- Brisk ankle & foot ex for unaffected leg to prevent circulatory complications.
- This exs are given form 1st day onward until patient ambulate.

Prevention of deformities

- Positioning in bed:
  - Stump should be parallel to the unaffected leg without resting on pillow.
  - Patient should lie as flat as possible & progress to prone lying when drains are out.
  - Pt with cardiac & respiratory problems may discomfort in prone lying, brought to supine.
  - Prolong sitting on soft mattress can predispose to development of hip flexion deformity.

Prevention of deformities cont…

- Exercise to counteract the deformity:
  - Strong isometric quadriceps ex - BKA
  - Hip extensor & add isometric ex - high AKA
  - Hip extensor & abd isometric ex - low AKA
  - Progression is made to free active & resisted stump ex.
  - Stump board - in BKA - stump should be rest on board when sitting in wheelchair.
  - Prolong sitting with knee flex should be avoided.

To control the stump edema

- Control environment treatment (CET):
  - Here, the dressing free stump place over a clear & sealed plastic sleeve which is attached to a pressure cycle machine blowing sterile warmed air over the wound.
  - The temp, pressure & humidity are set with ideal environment for healing of stump.

To control the stump edema cont…

- Pressure environment treatment (PET):
  - This is simpler version of CET
  - Here, the air is not sterilized, no temp control & limited pressure control.

To control the stump edema cont…

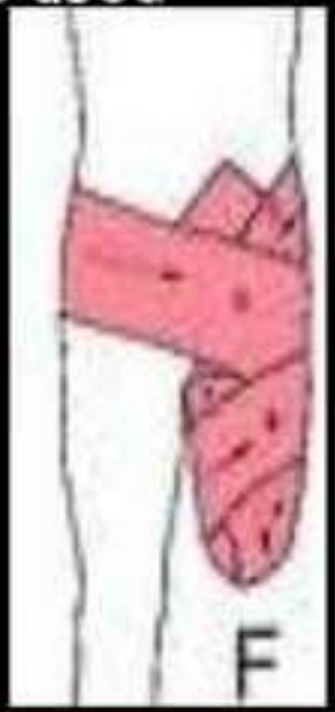
- Flowtron:
  - The stump is placed in an invaginated plastic bag.
  - The air pressure varies rhythmically, compressing & relaxing the stump to reduce edema.

To control the stump edema cont…

- Stump compression socks or bandaging:
  - Elastic stump compression socks (Juzo Socks) methods reduce edema & conditioning the stump.
  - Bandaging is controversial method of controlling stump edema particularly in vascular patient.
  - Pressure should be firm, even & decreasing pressure proximally.

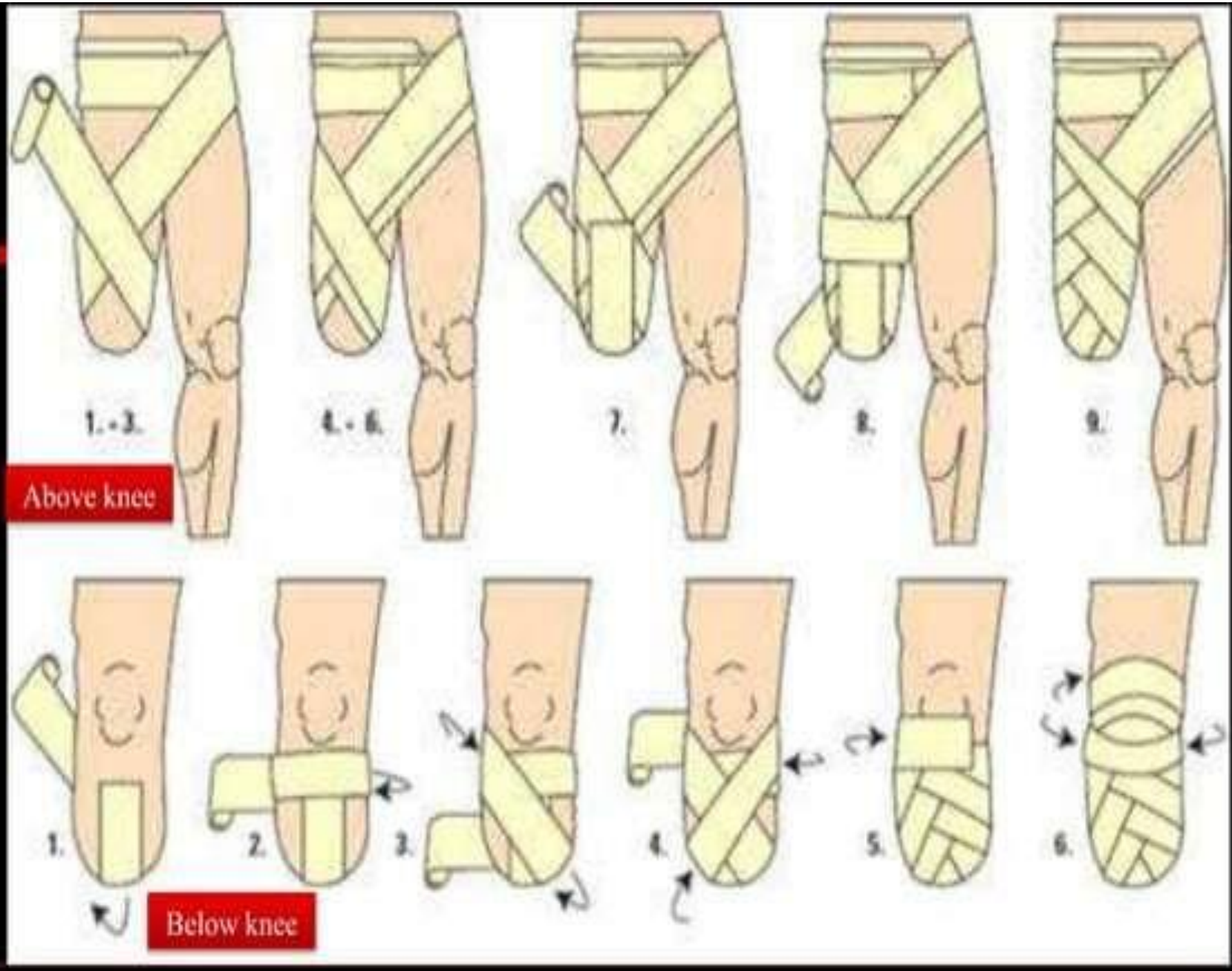
To control the stump edema cont…

- Stump compression socks or bandaging:
  - Diagonal oblique & spiral turn should be used rather than circular turns to prevent tourniquet effect.
  - **Bandage size:**
    - Upper limb - 4"
    - Lower limb - 6"/8"
    - Above knee - 6"
    - Below knee - 4"



Stump compression socks or bandaging:

- Above knee (AK) bandaging:
  - It should extend up to groin to prevent follicle infection due to friction with socket of prosthesis.
  - It should bandage with hip in extension & adduction.
- Below knee (BK) bandaging:
  - Stump should bandage with knee in slight flexion.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Above knee
1.
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Below knee

Maintain body strength & strengthen muscle controlling stump

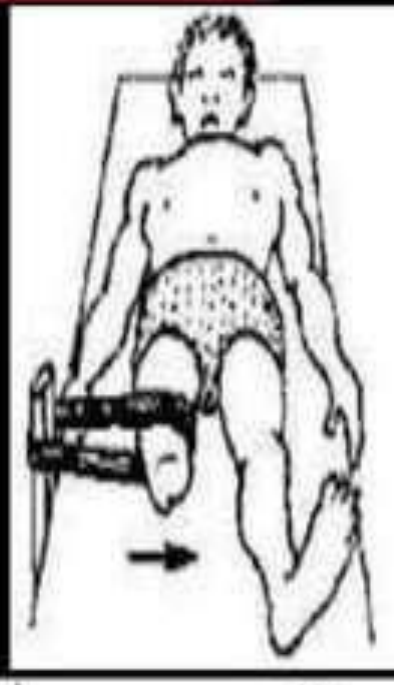
- Strengthening muscles are:
  - Shoulder - extensors, Adductors,
  - Elbow - extensors by working against weight or springs attached to bed.
  - Examples are:
    - Grasp stretch lying (shoulder extension & adduction)
    - Grasp lying (elbow flexion)
    - Sitting push up
  - *Strengthening of crutch muscle is very imp*

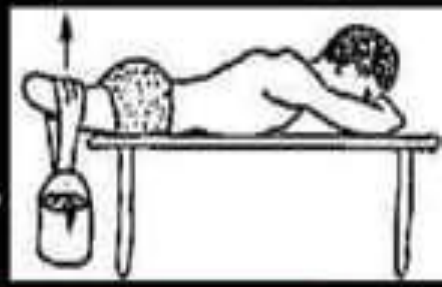
Exercise for unaffected side

- Lying:
  - Static quadriceps
  - Static gluteal
  - Straight leg raising (SLR)
  - Alternate hip & knee bending & stretching

Stump exercise

- Begins when the drains are out
- Gradually progressed from static to free active then resisted ex (PRE)
- In BKA progress to strengthening against resistance.
- In AKA prone lying leg lifting against resistance
  - E.g. manual resistance, weighted pulley, spring, theratube, theraband etc.





Maintain good mobility

- Exercise which moves the shoulder in all direction will maintain shoulder mobility
- Trunk movts in lying & sitting will improve trunk mobility

Improve balance & transfers

- Balance training
  - In sitting position by encouraging balance reaction, tapping, perturbation & trunk stabilization
- Training of transfer techniques
  - Wheelchair to bed
  - Bed to wheelchair
  - Wheelchair to toilet etc

Walking Re-education

- Partial weight bearing in parallel bar using pneumatic post amputation mobility aid (PPAM) 5 - 10 day post operatively
- Patient should wear normal dress & a good walking shoe on unaffected side.
- Initially preferred training in stable surface & progress to unstable surface. E.g. Walking in mud

Pneumatic Post Amputation Mobility Aid (Ppam)

- It is a partial weight bearing early walking aid that must only used under clinical supervision in the therapy facility, not for ward or home use.
- It can use from 5 -7 day postoperatively while the suture are still in the wound.

Ppam Aid Advantages

- Great psychological boost gained by walking soon after amputation.
- Reduction of oedema by pressure in bag.
- Postural reaction are re-educated by encouraging partial weight bearing.
- Preparation of the residual limb for hard socket of a prosthesis.
- This may help in reducing phantom sensation.

Ppam Aid Disadvantages

- If a fixed flexion contracture is present, the residual limb is more liable to break down.
- If the amputee is very heavy or heavy footed gait, excessive pistoning may occur & there will be insufficient support.
- Amputees used a stiff knee gait pattern, which is unnatural for those with the trans-tibial level.
- The inflation pressure may greater than the arterial pressure in the residual limb.

Walking without a prosthesis

- Using firm compression socks or bandage the gait training can be done in parallel bar
- Progress to - a frame or crutch depending on stability.
- Crutch user found less adaptation time to use a prosthesis
- Normal alignment of pelvis & reciprocal movt of stump should maintain.

Principle of Bandaging of Stump

- Pressure of bandage should be
  - Moderately firm
  - Evenly distributed
  - Decreasing proximally
  - Extra pressure over the corners - conical shape
- Pattern of bandage:
  - Diagonal, oblique or spiral
  - Not circular

PROSTHETIC STAGE

Main Aim at this Stage:

- To understand the components of prosthesis
- To independently fitting & removing of prosthesis & checking its fit
- To care of prosthesis
- To independent mobility – with or without walker
- To enable functional task with prosthesis
- To enable occupational & leisure activities
- To enable to cope with falls

Type of Prosthesis

- Temporary prosthesis
  - It takes approx 2 week manufacture
  - Quick & easy to manufacture
  - Cheaper, lighter & relatively simple to apply
  - Allow time for stump shrinkage to take place
- Final/ definitive prosthesis
  - It takes 2 - 3 month to manufacture
  - Measurement taken after shrinkage completed

Basic features of a Prosthesis

- Sockets -
  - Provides weight bearing & receptive area of stump
  - Interface between the patient and the prosthesis
- Suspension - holds the prosthesis to stump
- Joints - amputated joints are replace with artificial mechanical joints
- Base - provides contact with the floor

Material used for prosthesis

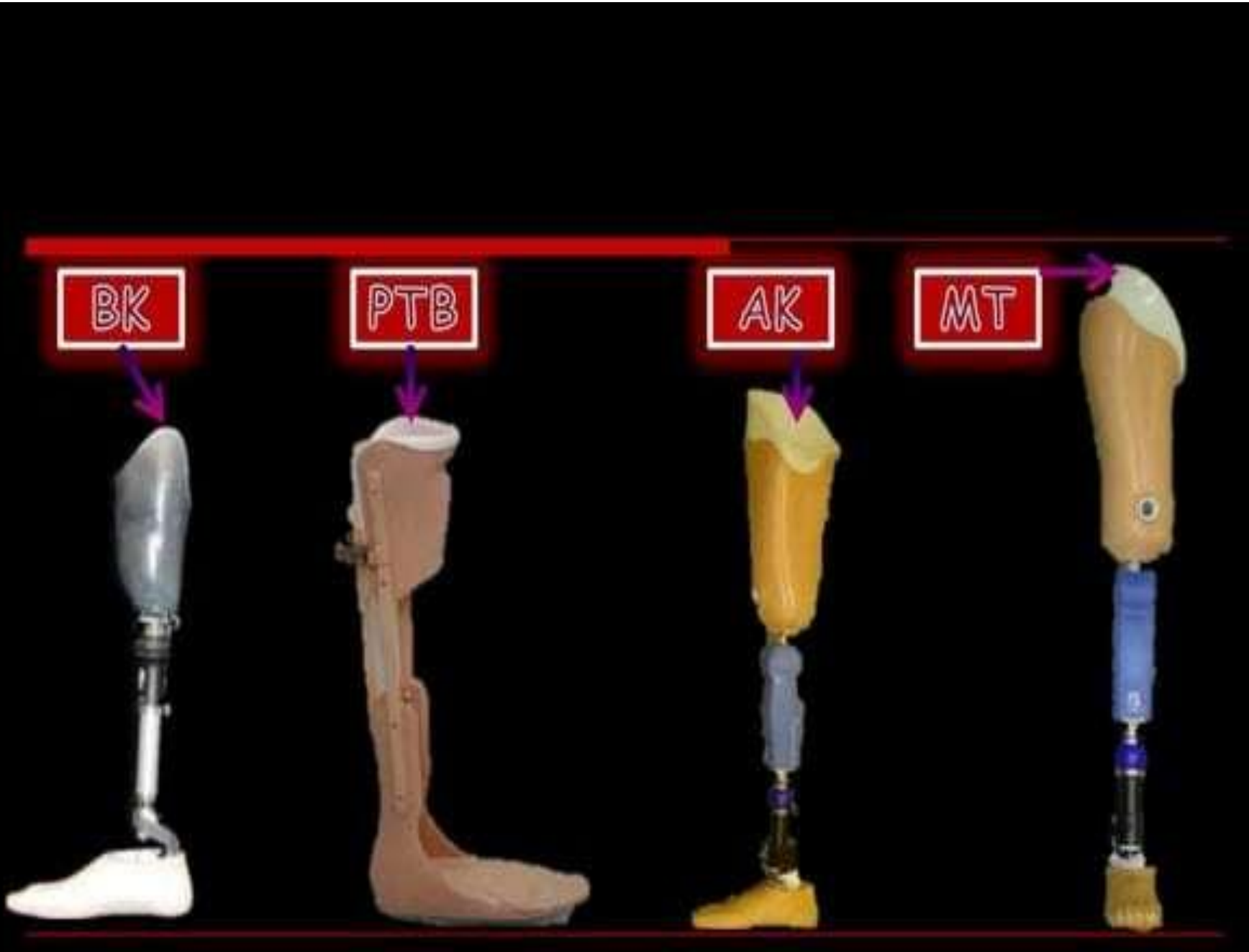
- Metal -
  - Steel & other alloys - for hip & knee mechanism
  - Duraluminium - for the socket & outer shell
- Leather -
  - Soft leather for straps
  - Hardened leather for thigh corsets
- Plastics -
  - Thermoplastic materials like polypropylene - for sockets
  - Plastic foam - to support distal tissue of stump
- Wood -
  - Preferred as a socket material & prosthetic feet in topical climate

Factors To Be Consider Before Prescribing Prosthesis

- Age
- General physique of the patient
- Mental conditions
- Length of the stump
- Status of stump circulation
- Level of amputation
- Strength, ROM & mobility related body segment
- Requirement of job & daily living

Prosthesis for Lower Limb Amputation

- Depending on the level of amputation
  - Transmetatarsal
  - Below knee
    - Patella Tendon Bearing (PTB)
    - Above knee - Below knee (AKBK)
  - Mid thigh


BK
PTB
AK
MT

Re-education with Prosthesis

- After satisfactory fitting of prosthesis the process of training & re-education begins.
- It include the following:
  - Correct methods of applying & removing of prosthesis
  - Early detection of any complication due to prosthesis
  - Functions of various component of prosthesis
  - Limitation of activities with prosthetic limb

Restore functional independence

- Taught to move up & down, side to side on the bed by pressing on the sole of stump
- Sitting up form lying by pushing down with the arm - begin when the drip are removed
- Good trunk rotation will make all reaching function easier

Restore functional independence cont...

- Functional training should start as soon as patient is able
- The exercise program should consist of
  - Resisted pulley work
  - Mat exercise
  - Slow reversal or repeated contraction
- The patient must be encourage to be as independent as possible

Treatment of Phantom Pain

- Pharmacological Rx
  - Injection with steroid or local anesthetic has reduced the pain temporarily
  - Intrathecal or epidural anesthetic with opioids used successfully
- Non invasive Rx
  - Such as - US, Icing, Icing, TENS or massage have been used

Treatment of Phantom Pain cont…

- Other methods -
  - Mild non narcotic analgesics,
  - Biofeedback,
  - Psychotherapy,
  - Nerve block & dorsal rhyzotomies have been used with inconsistent result.

GAIT TRAINING

COMMON ABNORMALITIES INWALKING WITH A PROSTHESIS

- The common problems encountered in walking with a prosthesis can also be divided into
  - Stance phase problem or
  - Swing phase problem.

Stance Phase Problems with a BK Prosthesis

- Problems commonly encountered in the stance phase of walking with a prosthesis include
  - "Buckling" of the knee,
  - "Snapping back" of the knee,
  - "Foot slapping," and
  - "Vaulting."

Reasons for knee buckling

- Weak quadriceps:
  - Can't straighten the knee when heel strikes the ground. This can be corrected by a muscle strengthening program.
- Pain from an ill-fitting socket:
  - Changing the socket might solve this problem.
- A poorly-aligned prosthetic foot, or one with a heel that is too hard: These also can be corrected.

Causes of snapping back

- Weak thigh muscles or poor alignment of the socket and the foot.
- Fear of knee buckling is offset by keeping the knee as straight as possible when heel strikes in early stance phase.
- One way of keeping it straight is to "snap" the knee back.
- Over time, this can cause pain & deformity in knee.

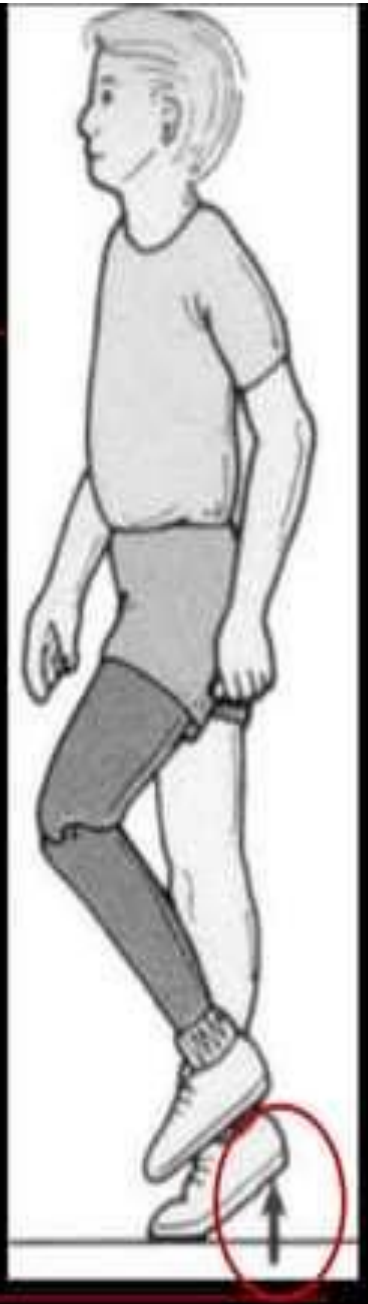
- The knee may snap backwards because of a soft heel or a foot that points downward more than it should.
- A good muscle strengthening program for the thigh muscles is important to overcome this problem.
- Additionally, your prosthetist can check the socket to ensure that there is a good fit and alignment.

Causes of slapping

- A prosthetic foot that slaps the floor while walking can be the result of a problem with socket alignment or the foot.
  - E.g., there may be a slapping sound if the foot is pointing up too much when the heel strikes the ground.
  - This can also potentially cause the knee to buckle.

Vaulting

- It is the term used when you lift your body up onto the ball of sound foot in order to swing your prosthetic leg forward.



Reasons for vaulting

- The prosthesis is too long, and as a result you feel that you are going to trip over it as you walk.
- It is compensate by raising entire body off the ground with sound foot.
- Other reasons include inadequate suspension of the prosthesis or an ill-fitting socket.
- These problems can be addressed by correcting the length of the prosthesis.

Swing Phase Problems with a BK Prosthesis

- The problems encountered during the swing phase are related to inability to advance the leg.
- This may be the result of -
  - The prosthesis being too long,
  - Being inadequately suspended, or
  - Having a contracture at knee, which limits the ability to flex & extend the knee effectively.
- Pain from a poorly fitting prosthesis or fear of taking steps may affect swing phase.

Swing Phase Problems with a BK Prosthesis Cont…

- These are all correctible.
  - The length of the prosthesis can be adjusted;
  - The suspension can be improved;

Gait Problems in AK Amputees

- The most common problem encountered by the AK amputee is flexion & extension of knee during stance phase.
- May feel that knee will buckle & cause to fall.
- As a result, fearful of walking and take small, cautious steps to compensate.
- This problem can be corrected by changing the alignment of the knee to make it more stable during stance phase.

Gait Problems in AK Amputee Cont…

- Knee-buckling during stance phase that are not related to the use of a prosthesis;
  - E.g., weak gluteal muscles on the prosthetic limb. This can be remedied by strengthening program.
- Prosthesis stick out away from the body during stance phase as a result of a muscle imbalance between adductor & abductor.
- Strengthening of adductor muscle groups is important.

Gait Problems in AK Amputee Cont…

- Too much bending of trunk during stance phase.
- This can result from an ill-fitting socket, a short prosthesis, or weak hip muscles.
- Vaulting can be seen with an AK prosthesis (same as BK prosthesis).
- It can be caused by a prosthesis that is too long or inadequately suspended.

Gait Problems in AK Amputee Cont…

- *Circumduction* is the term that is used to describe a wide arc-like movement of the prosthetic limb during swing phase.
- Typically, it results from a prosthesis that is too long.
- The prosthesis may appear to be too long if the suspension is inadequate or the prosthetic knee does not bend.

The Importance of the Hip Muscles

- Weakness in key muscle groups around the hip and contractures or tightness of the hip joint can have a profound impact on ability to walk with a prosthesis.
- It can make walking awkward and force to use more energy than it should.
- It may become over cautious every time they take a step.

4 key muscle groups in the hip

- Hip flexors are responsible for advancing the leg forward during swing phase.
- It may find it difficult to advance the limb during swing phase if they are weak.

- Hip extensors help pull the leg backward, stabilizing it during the stance phase.
- If they are weak, there may be a buckling or unsteady sensation at heel strike the ground during stance phase.

- Hip abductors pull the leg away from the body.
- They will walk with an excessive bending of trunk if abductors are weak.

- Hip adductors pull the prosthetic leg toward the body.
- They will walk with the prosthetic limb extended away from body if they are weak.

Criteria for gait training

- Gait training should be perform in front of full length mirror to observe & correct any fault
- Increase the walking time each day
- Inspect the stump at the end of day
- Young, fit amputees will required 1week training
- Elderly, will required 2week or more training.

Training In Parallel Bar

- Standing balance with equal weight on both legs.
- Correct method of weight transfer on individual leg
- Weight transfer on both legs alternatively.
- PNF techniques of resistive gait, rhythmic stabilization & approximation are emphasized.
- Normal coordinated stepping with both hand support.
- Progress to single hand support.

Training In Parallel Bar cont…

- Raising to standing form sitting & back.
- Side walk & turning
- Reasonable gait progression is made by walking with one stick in appropriate hand

Home visit

- A home visit should be made prior to discharge from the hospital
- An assessment for floor coverings, stairs, steps, door widths necessary for ramp, additional rails, access to bathroom, facilities in kitchen for cooking & washing
- Proximity of shops

Final Rehabilitation

- It involves the patients returning to a normal active everyday life
  - Participation in sports such as squash, tennis, golf etc.
  - Functional independent in case of elderly
  - Falling without injuries
- Set a follow up

Safety falling techniques

- Should be start on mat with precaution
- Progression should be made by transferring to various falling surface

HOW TO PREVENT FALLS

- There is a risk of fall after limb amputation
  - E.g., It may happen in the middle of the night when you get up to go to the bathroom because you do not remember that you are missing a leg.
  - Although most of the time nothing serious will happen, apart from you may break a bone, hit your head, or cut yourself.

HOW TO PREVENT FALLS Cont…

- First, it is best to have a safe home that minimizes risk of falling.
- Second, must have a prosthesis that fits well & is not at risk of breaking or malfunctioning.
- Third, should know how to get up from the floor if fall, and how to call for help if cannot get up.

Suggestions for modifying home to prevent falls

General -

- Remove loose rugs
- Chairs should have arms
- Free of clutter
- Adequate lighting

Specific Rooms

- Bathroom
  - Grab bars in the tub
  - A tub bench or seat
  - A handheld showerhead
  - Adequate lighting
  - Non-skid mats
  - An elevated toilet seat
- Bedroom
  - Flashlight in nightstand

WEIGHT ISSUES IN WALKING WITH A PROSTHESIS

- Weight gain can cause residual limb to increase in size, making more difficult to put on the prosthesis.
- If the prosthesis is not on correctly -
  - It will make difficult to walk in smooth, energy-efficient, and attractive manner.
  - It can also cause skin irritations and infections.
  - It can even cause fall also.

WEIGHT ISSUES IN WALKING WITH A PROSTHESIS Cont…

- It is important to discuss any weight gain or loss with prosthetist and physician.
- Changes in prosthesis may be necessary if unable to lose weight.
- These changes may include the fabrication of a new socket.

Follow-Up Visits to Rehab Clinic

- Tell your doctor if you are experiencing any of the following:
  - Areas of redness, cuts or skin irritations on the residual limb
  - Areas of pressure over bones on residual limb
  - Falls or near falls
  - Phantom pain
  - Low back pain

Follow-Up Visits to Rehab Clinic cont…

- Sensations that the residual limb is moving up and down within the socket (pistoning). This is similar to walking with a pair of shoes that are too big.
- An ill-fitting prosthesis
- Pain in the residual limb when putting on the prosthesis or taking it off.
- Pain in the opposite, remaining lower limb

- Problems with respect to dressing, bathing, transferring from bed to chair, or getting in and out of a bathtub
- Any problems with the skin on the opposite foot, such as redness, cuts, and bruises. These are typically on the ball of the foot, and may be difficult to see.
- Any recent weight loss or weight gain

Roll of rehab team in follow-up visits

- Examine skin of residual limb for any evidence of -
  - Blisters, infections, or abnormal areas of pressures on bones
  - Also examine skin on opposite, remaining limb.
- Check the ROM of the residual limb for the presence of a contracture.

- Examine the strength of arms & legs, and ability to get up from a seated position.
- Examine gait with prosthesis for a short distance to see if there are any alignment or fit problems with the prosthesis.
- After this short period of ambulation, skin should be checked again for any areas of abnormal pressure on the bones.

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Gangrene

- is necrosis & subsequent decay of body tissues caused by infection or thrombosis or lack of blood flow.
- It is usually the result of critically insufficient blood supply caused by injury and subsequent contamination with bacteria.
- This condition is most common in the extremities.

- The best of all Rx is revascularization (restoration) of the affected organ, which can reverse some of the effects of necrosis & allow healing.
- Depending on the extent of tissue loss & location, Rx other than revascularization runs the gamut to auto-amputate (fall off), debridement and local care, to amputation, the removal of infected necrotic tissues.

Gangrene - Types

- **Wet Gangrene** – Gangrene caused by a serious bacterial infection.
- **Dry Gangrene** – Gangrene caused by lack of circulation in an injured or diseased area.
- Example
  - *Diabetic foot* in long-standing complicated diabetes. It is caused by a combination of arterial ischemia, injury & poor healing in diabetics. It often combines poor healing with a superimposed infection.

Gangrene - History

- In the years before antibiotics, fly maggots were used to Rx chronic wounds or ulcers to prevent or stop necrotic spread.
- Some species of maggots consume only dead flesh, leaving nearby living tissue unaffected.
- Largely died out after the introduction of antibiotics & enzyme Rx for wounds.

Gangrene – History cont...

- In recent years, maggot therapy has regained some credibility and employed to great effect in cases of chronic tissue necrosis.
- The most common surgical Rx for irreversible gangrene is immediate Amputation, as the infection grows 2-3cm/hr. Gas gangrene

Gangrene - Pathophysiology

Gangrene - Wet gangrene

- Wet gangrene is more familiar of two types, at least in media portrayals.
- An injury, such as a gunshot or laceration, leads to a bacterial infection, which produces pus.
- If the pus does not drain well, the blood supply to the area is blocked, and the oxygen.

Gangrene - Wet gangrene cont…

- When O2 supply cut off, the tissue dies.
- Rx of the underlying infection is necessary, removal of the dead tissue.
- Without Rx, the infection can spread further & destroy large amount of tissue.
- Eventually, sepsis & death can result.

Gangrene - Dry gangrene

- If the blood flow is interrupted for a reason other than severe bacterial infection, the result is a dry gangrene. Persons with impaired peripheral blood flow, such as diabetics, are at greater risk for dry gangrene.

Gangrene - Dry gangrene cont...

- The early signs of dry gangrene are a dull ache and sensation of coldness in the area, along with pallor of the flesh. If caught early, the process can sometimes be reversed by vascular surgery. However, if necrosis sets in, the affected tissue must be removed just as with wet gangrene.