Paper I: Upper Limb prosthetics and orthotics and Spinal orthotics

Chapter 5: Upper limb prosthetic components, suspension and harness design

Intake 2016

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Contents

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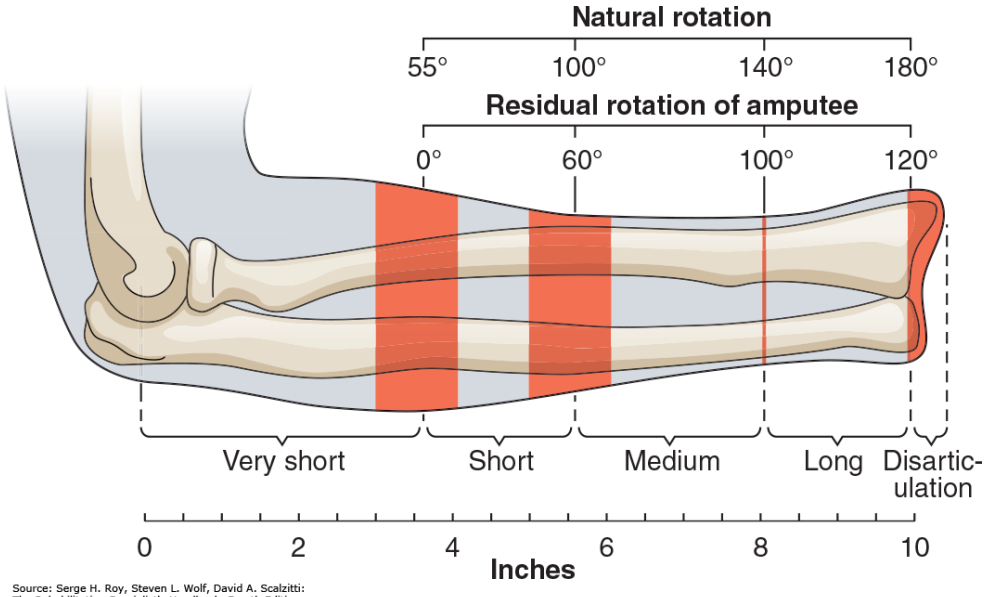
1.Socket

- The common material for TR socket:
  - Lamination socket by acrylic resin or polyester
  - Polypropylene or leather
  - Silicone or Pe-lite soft liner

1. Socket: Trans-radial prosthesis

The four basic designs of TR socket are:

- Plug-fit (or standard)
- North Western
- Muenster
- Strathclyde Supra Olecranon socket



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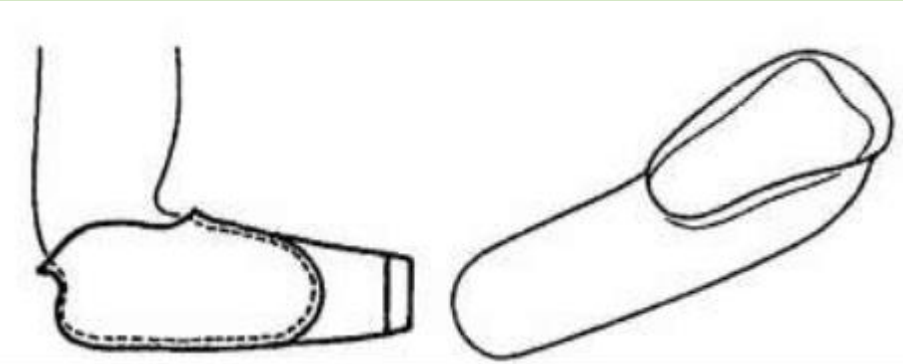
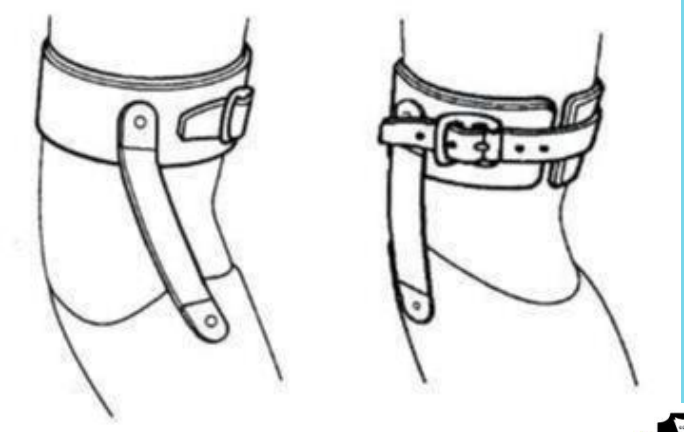
2. Suspension

- **Supra-condylar self suspension socket**
  - Northwestern socket
  - Muenster socket



- **Cuff**
  - Leather cuff
  - Suspend above epicondyles



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2. Suspension

- **Liner**
  - Made from silicone
  - Be rolled onto the stump
  - A lanyard or pin attached

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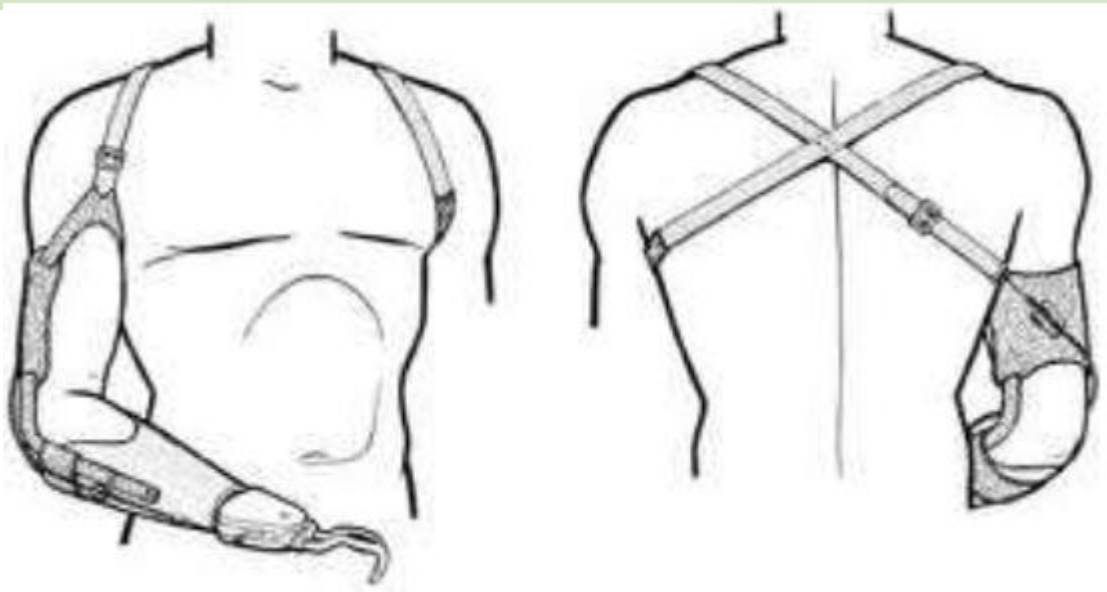
2. Suspension

Types of TR Suspension

- **Strap** (Front support strap)
  - Attached to the socket
  - Extending across the shoulders in a figure of 8



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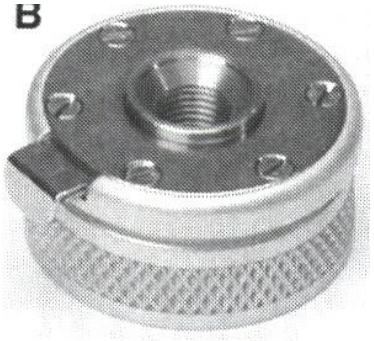
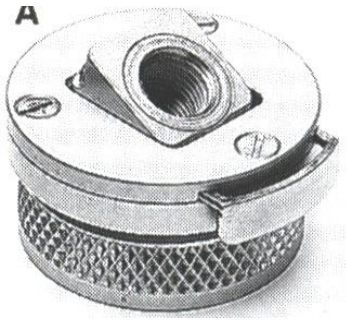
3. Wrist units



- Attach terminal device to prosthesis
- Allow active or passive pronation and supination to position terminal device.
- Various types
  - Quick disconnect - Screw fitting
  - Permanent fixation units - Wrist flexion
  - Rotational wrist units - Friction wrist unit
  - Constant friction wrist unit
  - Multi directional ball and socket wrist joint



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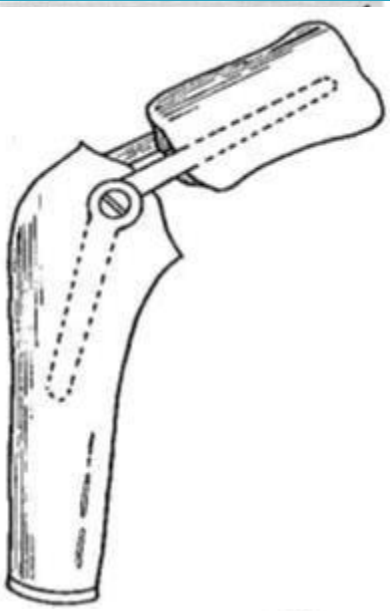
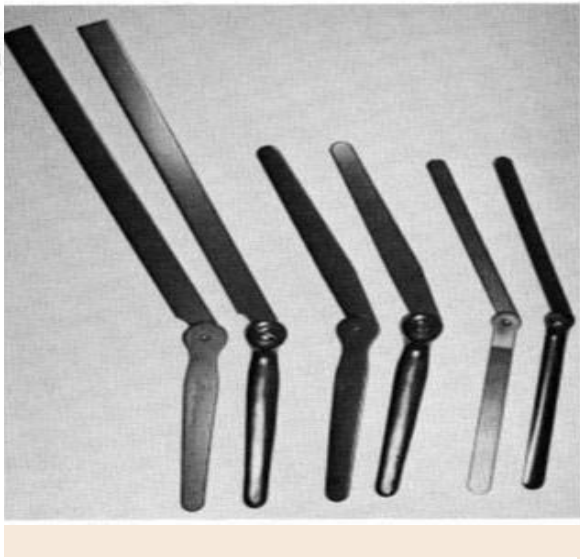
4. Elbow unit for TR

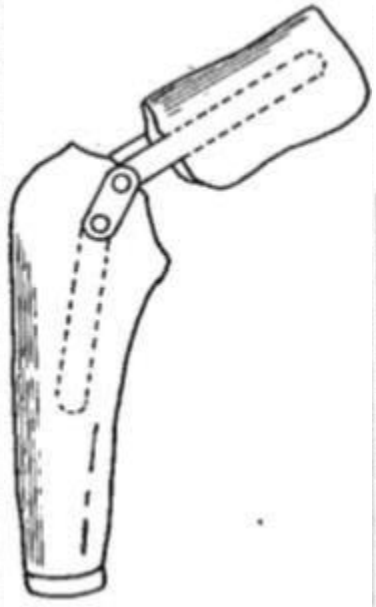
Rigid Hinges

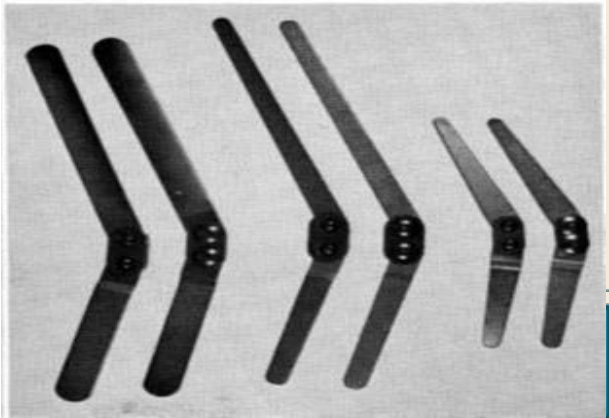
- **Single-Axis:** are designed to provide axial (rotational) stability between the prosthetic socket and residual forearm during active prosthetic use.





- **Polycentric Hinges:** help to increase elbow flexion by reducing the tendency for bunching of the soft tissues. Suitable for short stump case.

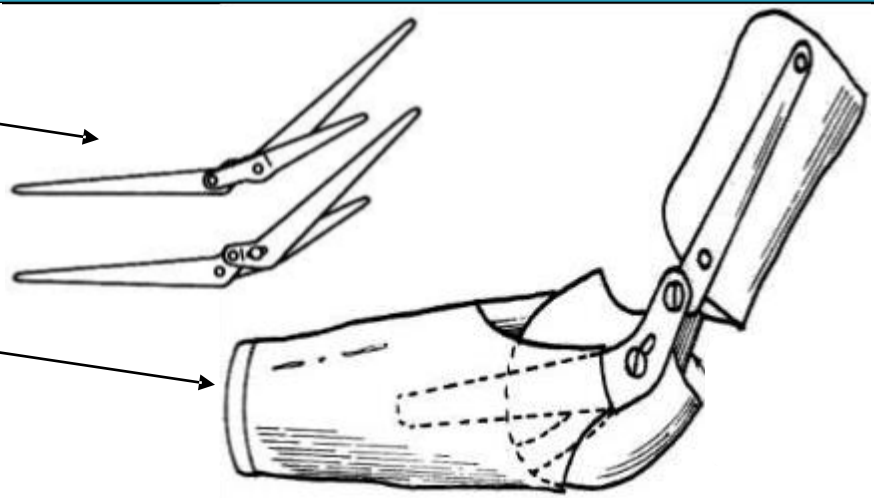




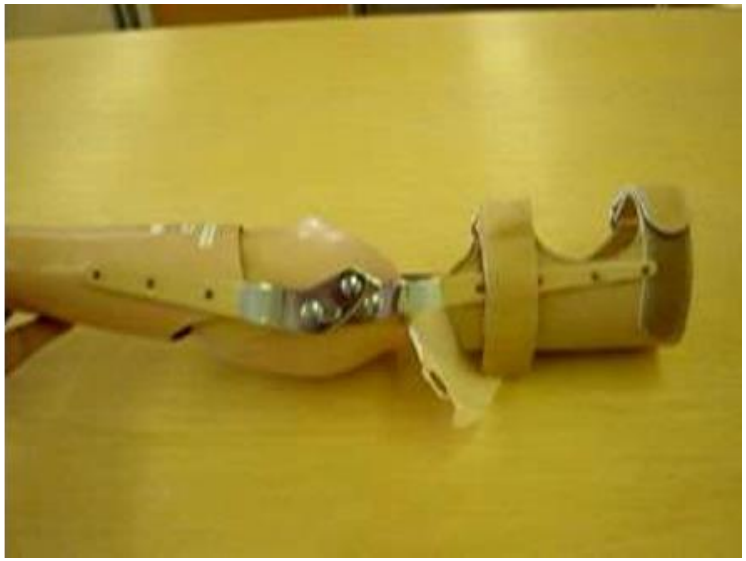
4. Elbow unit for TR

Step-Up Hinges

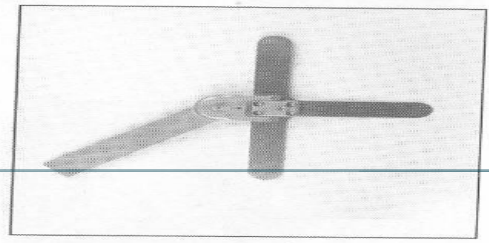
The use of step-up hinges requires that the prosthetic forearm and socket be separated such as split socket.

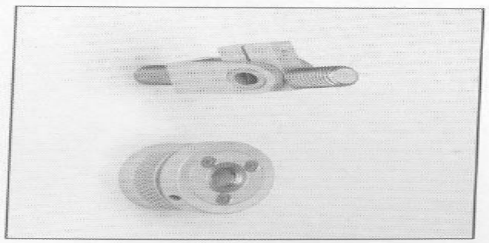


It’s suitable for a patient who has limited elbow flexion such as very short stump case.



Shoulder units

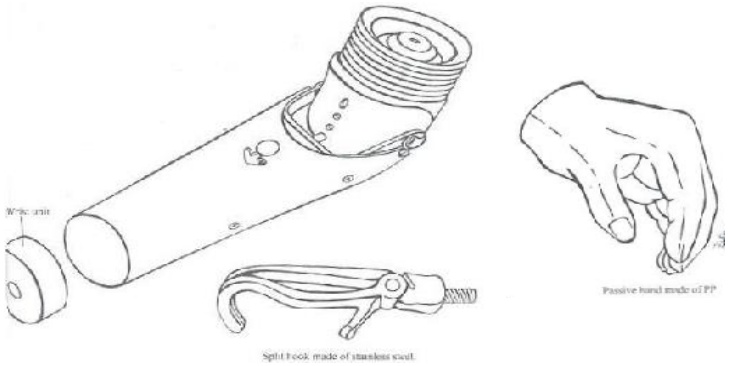




- Not always necessary for shoulder disarticulation or forequarter amputation
- Allow passive movement for positioning prosthesis (flex/exten)
- Can be uniaxial, biaxial (abd/add) or multiaxial

ICRC components

- Polypropylene elbow with manual lock and friction rotation control for positioning elbow and forearm.
- Polypropylene wrist unit
- Stainless steel split hook
- Polypropylene passive hand



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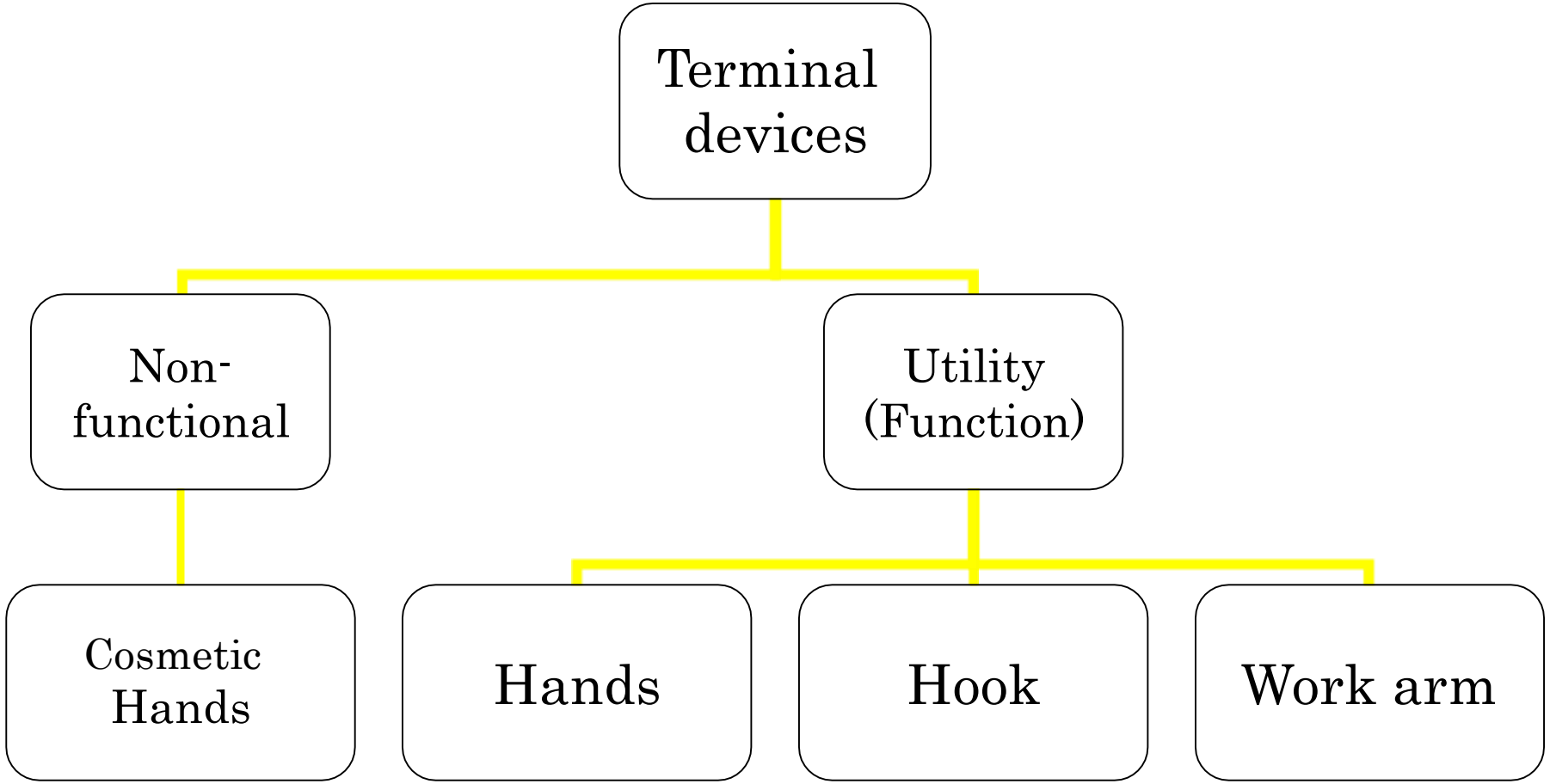
5. Terminal Devices



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5. Terminal Devices

- **Non functional/ Passive TD**

- It is opened with the ***sound hand***
- It is lightweight and stable

Passive /cosmetic

- Two types of passive TD
  - **Passive/cosmetic hand**
  - **Passive mitt hand**– Soft foam

    for a child to practice bi-manual

Passive baby mitt

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5.Terminal Devices

- **Utility or functional terminal device**

- Can be body powered or externally powered
- Subdivided into 2 types:
  Hand and ***Hook-like*** shapes

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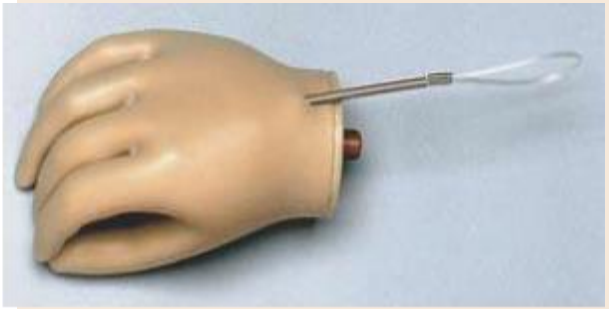
5.Terminal Devices

Utility/ Mechanical Hand

- Opened and closed by a cable (**body powered**) or battery
- Two system, *Voluntary opening (VO)* and Voluntary closing (VC)
- Covered by soft foam (PVC)
  - Good cosmetic appearance
- Provide a three-jaw chuck grip



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5.Terminal Devices

Voluntary Opening (VO)

- Opening is activated by pulling the control cable

- The amputee uses body power to open the TD and the tension of the TD spring provide the prehensile force to grasp the object

5.Terminal Devices

Voluntary Closing (VC)

- Clossing is activated by pulling the control cable

The amputee releases the lock, and spring tension opens the hand to grasp an object

- The prehensile force is controlled by the tension of the spring

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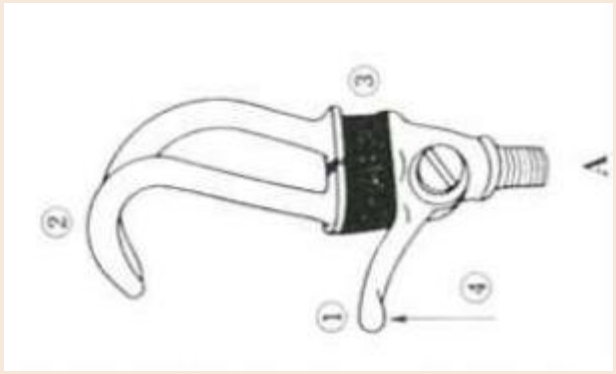
5.Terminal Devices

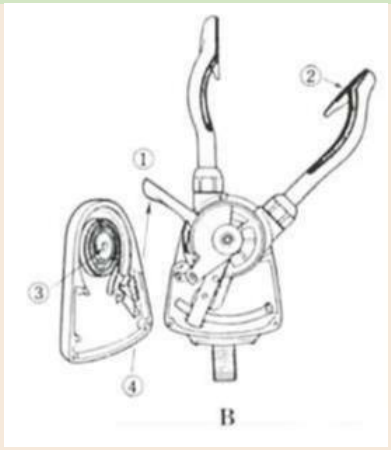
- **Utility hook**

- *Hooks* provide lateral or key grip
- Activated by pulling a cable
- automatically under spring or rubber tension
- Two system: VO and VC



Name of each parts

1/ The thumb of hook
2 / Hook
3/ Power source
4/ Cable



Voluntary Opening (VO)

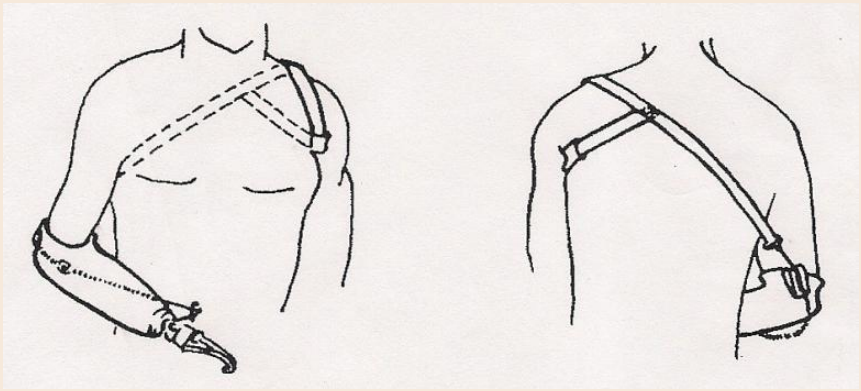
Voluntary Closing (VC)

5.Terminal Devices

Body powered

- Use a combination of hardness, control step and cable along with the body movement to operate the terminal device.

- In TR the terminal device operate by
  - Elbow extension
  - Shoulder flexion
  - Shoulder girdle abduction (Protraction)



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5.Terminal Devices

Externally powered

- Are controlled by switches or myoelectric signals

Myoelectric-controlled TDs

- Use surface electrodes placed on the muscles of the residual limb.

- Micro-switch-controlled TDs
  — use either a push-button switch or a pull-switch to operate the TD

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5.Terminal Devices

- **Work arm**

- Design for specific work
- Made according to amputee's request

E.g. typing tool

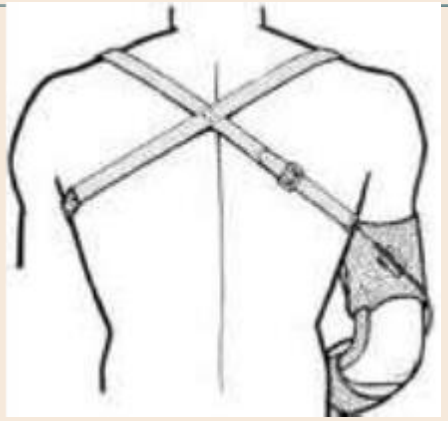
(1)Clamp	(4)Movable Ring
(2)Hook	(5)Car Steering Bar
(3)Ring	(6)Steering Knob

6. Control System in TR

5-1 Harness

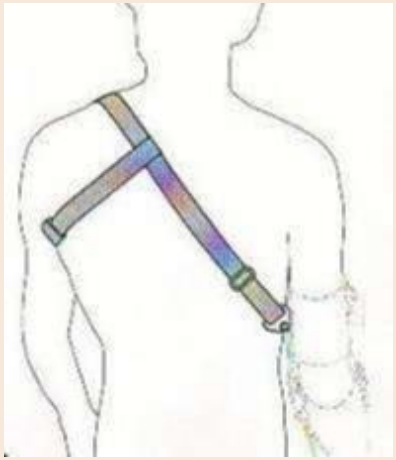
- **Figure 8 harness**

  - Helps the suspension and the controlling of the terminal device (TD)



- **Figure 9 harness**

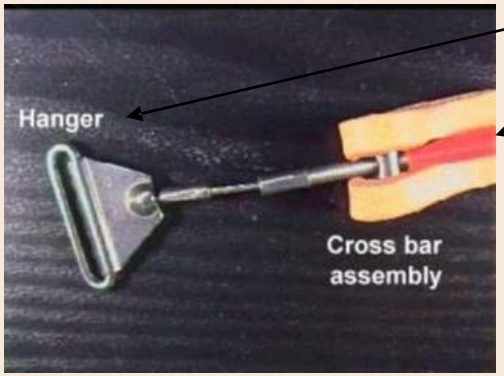
  - More simple than figure 8 harness
  - Helps only controlling of TD
  - Suspension should be self-suspension socket



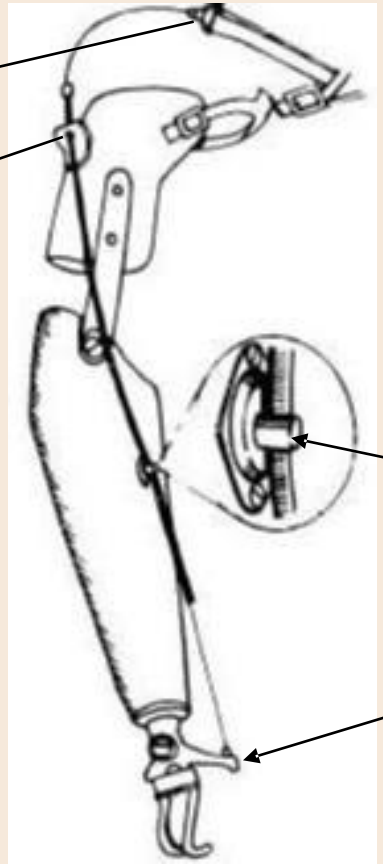
6. Control System in TR

5-2 Control cable system for TR

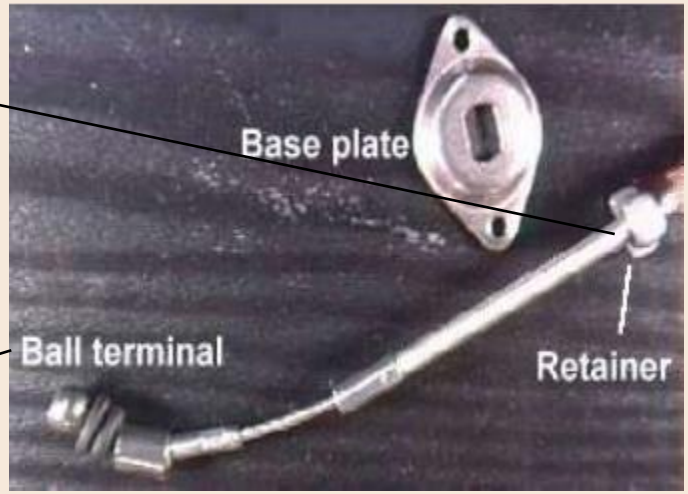
It's called single control cable system or Bowden control cable system which can control the terminal device.



1. Hanger
2. Cross bar assembly

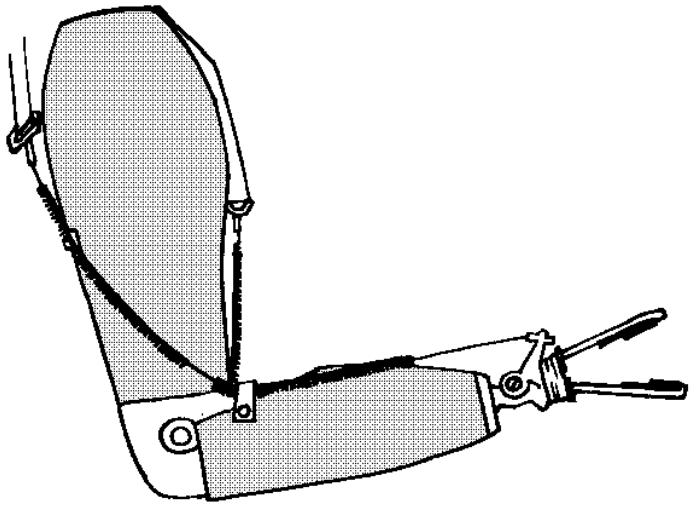


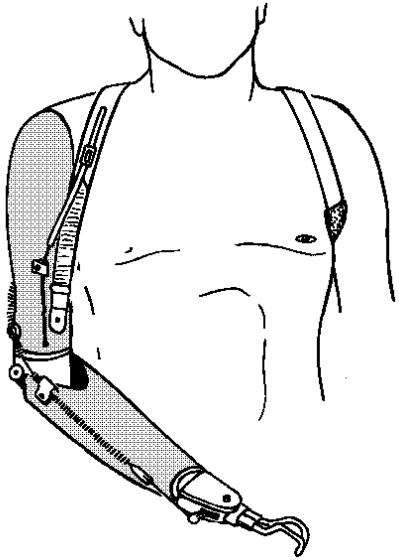
3. Base plate
4. Retainer
5. Ball terminal
6. Cable
7. Cable housing

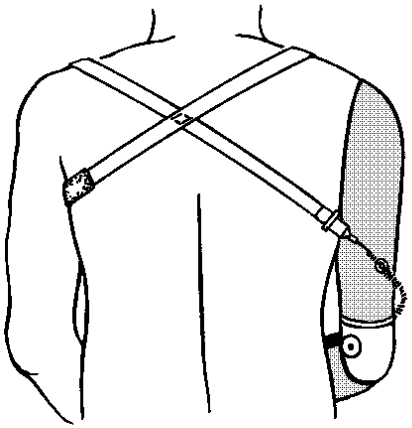


Control cables

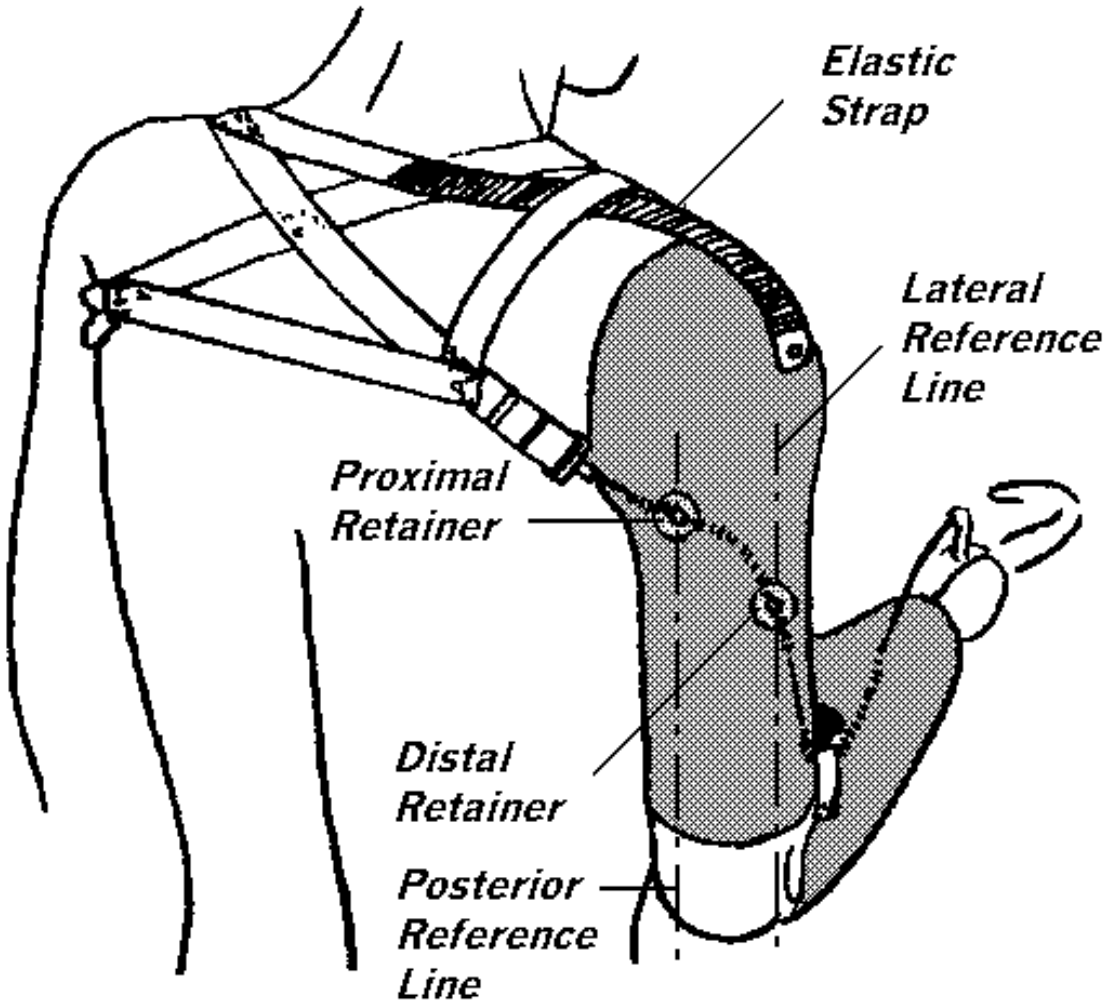
- To control terminal device and elbow flexion operation







Cable control



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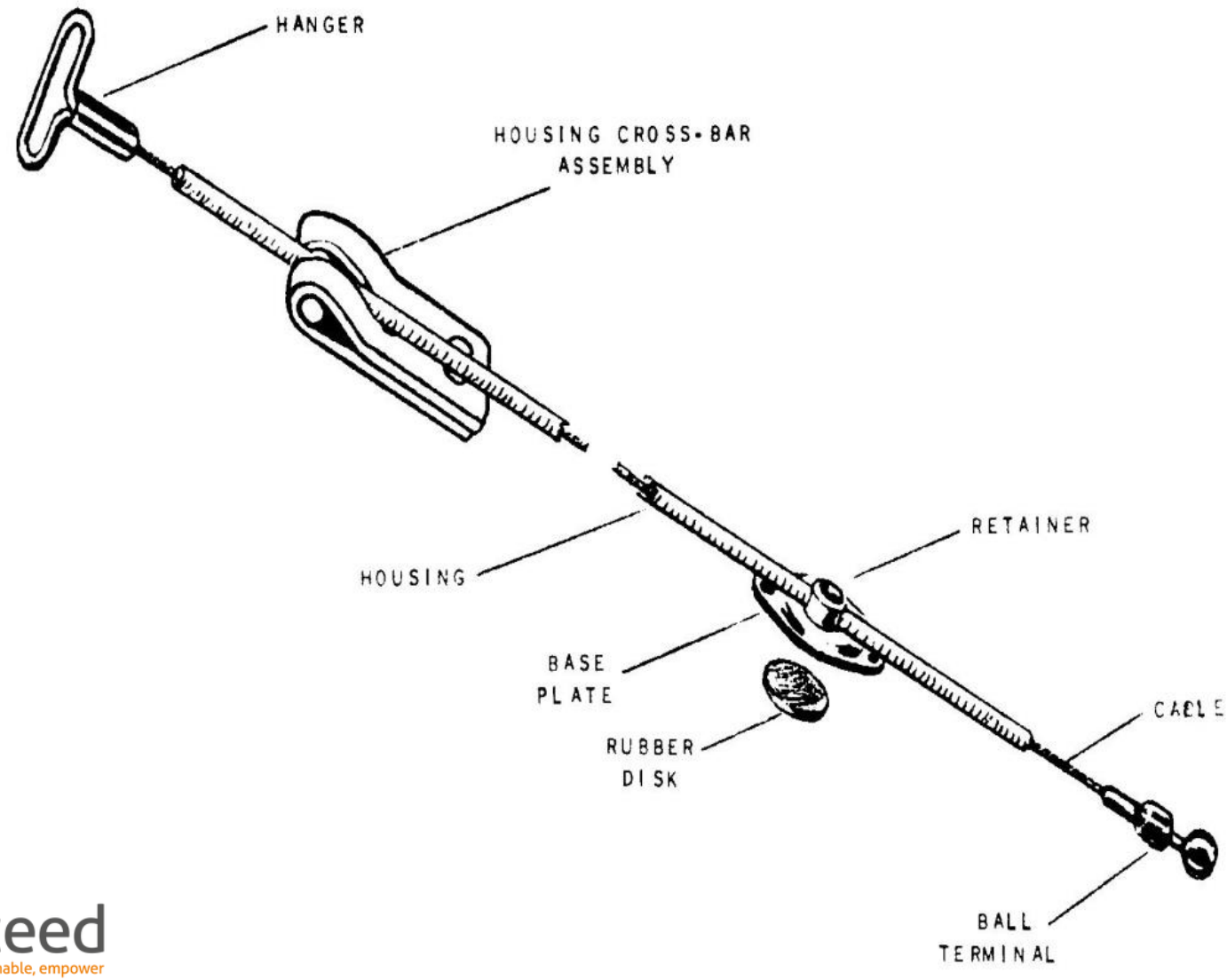
Cable Control



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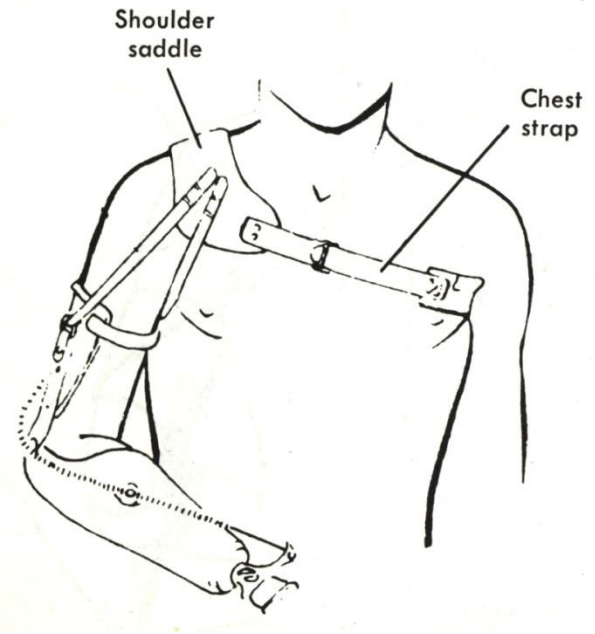
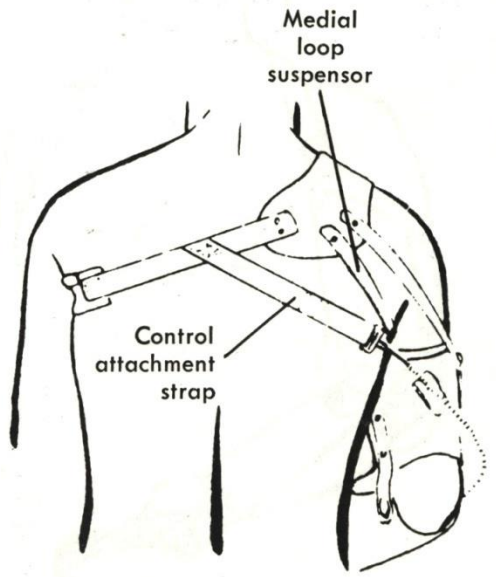
Heavy duty shoulder saddle





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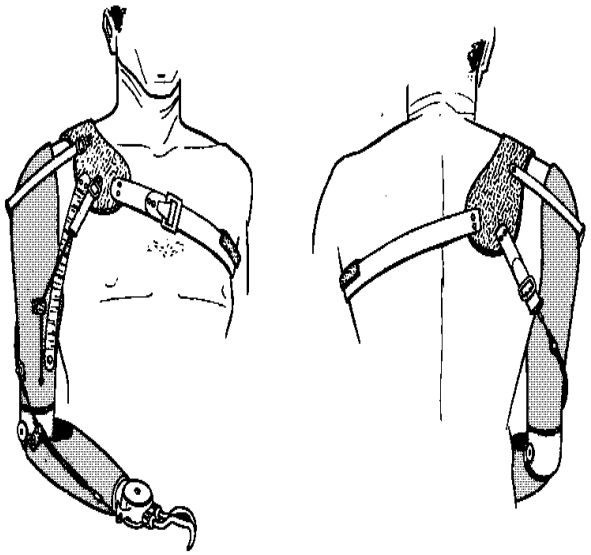
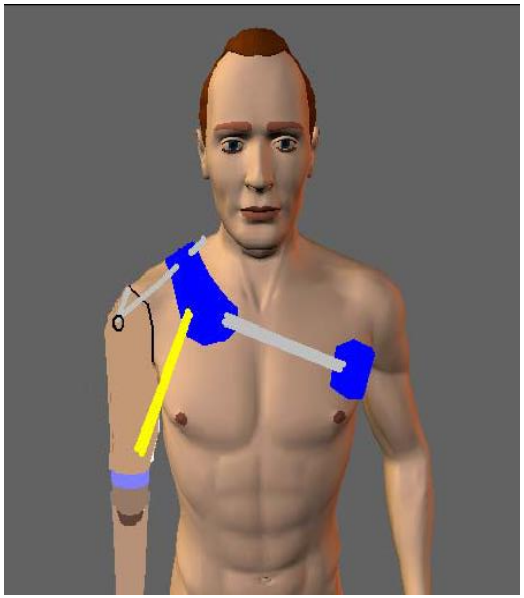
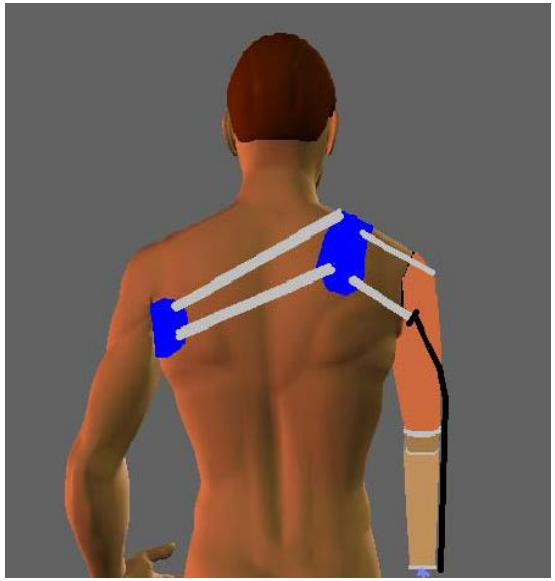
Shoulder saddle can be made with various designs







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7. Gloves

- **Silicone gloves**

Advantages over the PVC and Latex gloves

- Easier to clean
  - More resistant to stains and
- More realistic finish
  - High cosmetic finishing
  - Matching color duplication

Disadvantages over PVC gloves

- Expensive
- Tear and damaged easily

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7. Gloves

- **PVC gloves (polyvinyl chloride)**

Advantage over Silicon

- Good stretch and recovery
- Resistance to weather and chemical
- Cheaper than silicone gloves

Disadvantage over Silicon

- Difficult to clean - Easy absorbent
- Requires prompt cleaning to prevent permanent marking

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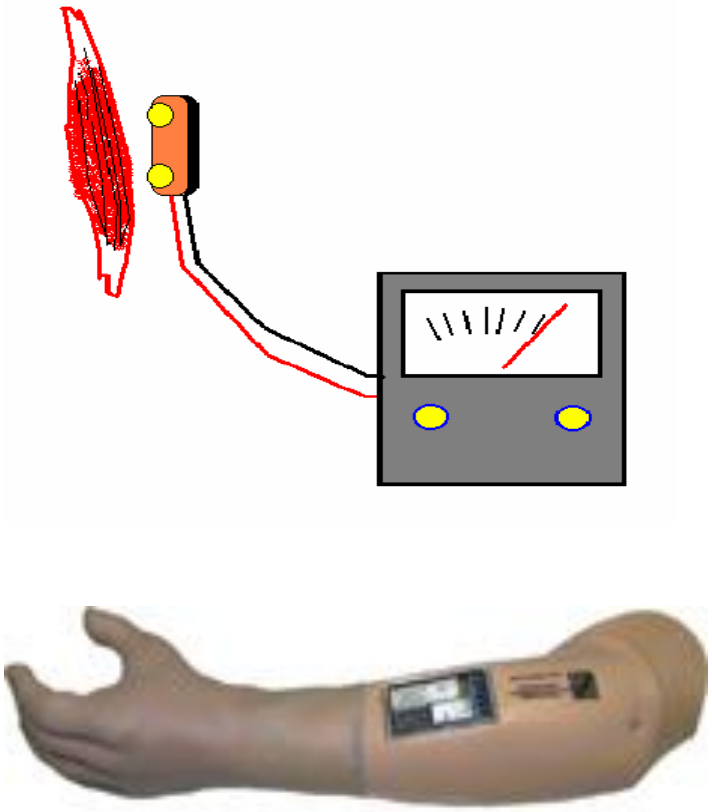
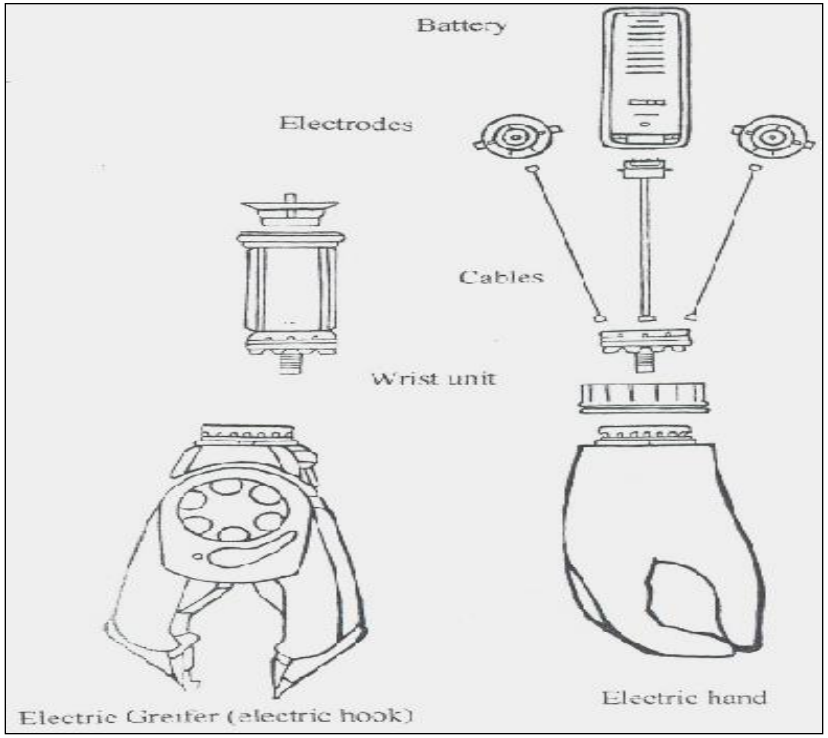
Myoelectric

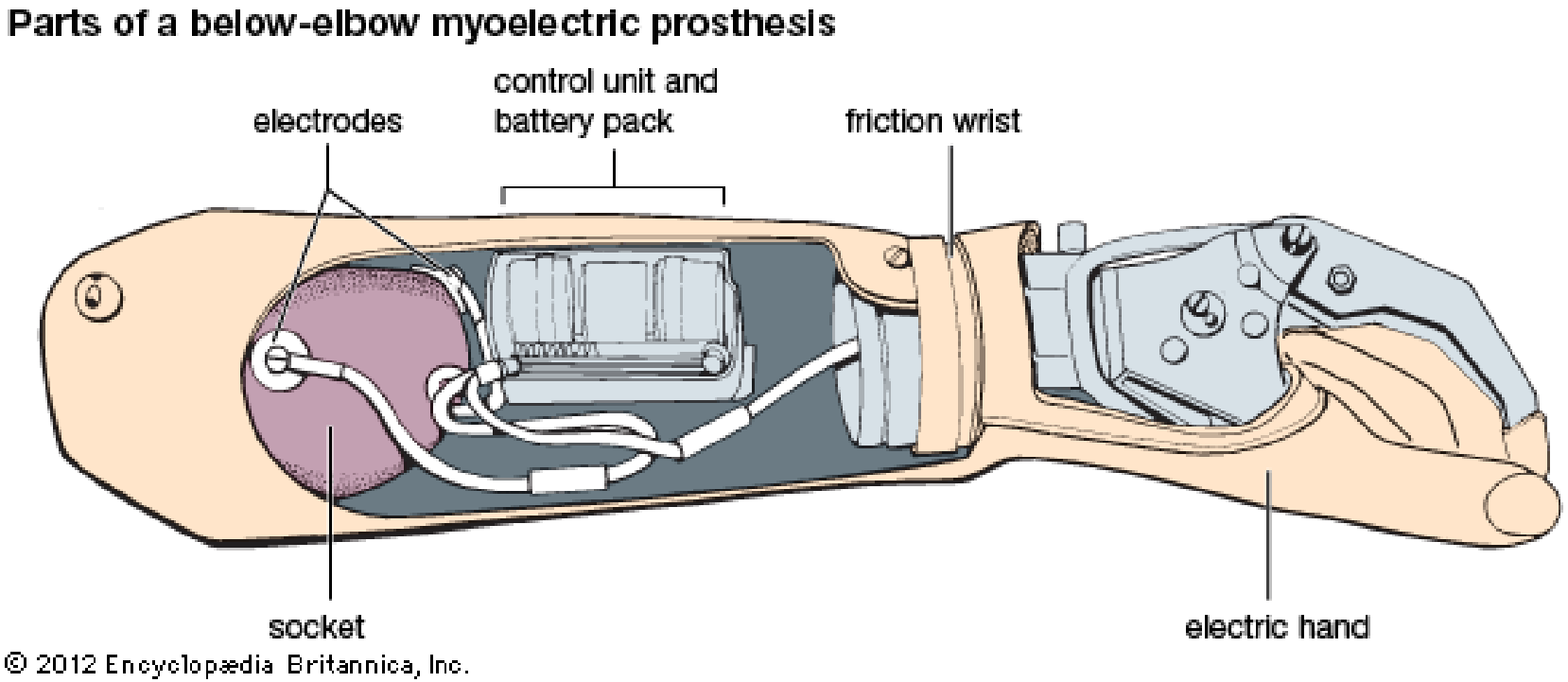
- Myo=Muscle
- Prosthesis controlled through muscle impulses
- Electrodes placed on skin receive electrical impulses when muscle contracts.
- Filters & Rectifiers
- Impulses amplified by amplifier
- Battery powers the motor which moves the terminal device (Eg. 100µV at 100hz signal)

Myoelectric Signals





Myoelectric



Group work

Each group is to think of with 3 advantages and 3 disadvantages of the harness system they are allocated.

Gp 1: Figure of 9

Gp 2: Figure of 8

Gp 3: Shoulder saddle

References

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Questions???

Thank You

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