SNS COLLEGE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION)

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Department of Biomedical Engineering

Course Name: 19BMT204 Biomedical Instrumentation

II Year : IV Semester

Unit IV – SKELETAL MUSCULAR EQUIPMENT

Topic : ELECTROMYOGRAPHY

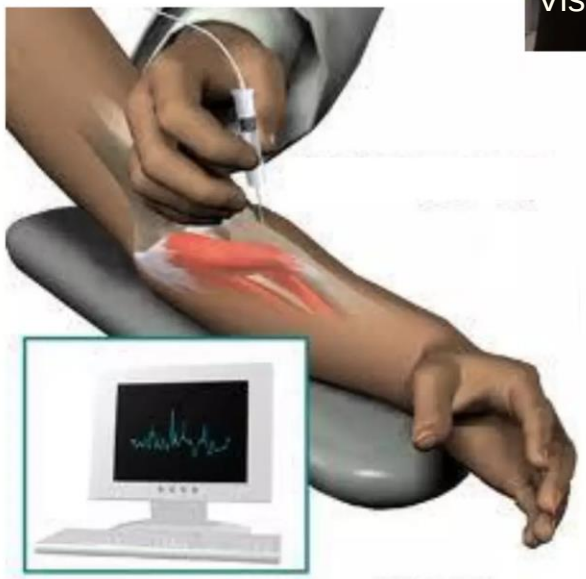
Electromyography (EMG)

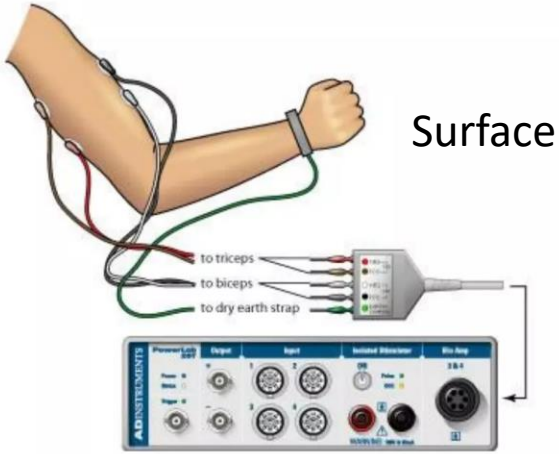
- is a technique for evaluating & recording the electrical activity produced by skeletal muscles.
- is performed using an instrument called an electromyography, to produce a record called an electromyogram
- A resting muscle does not show recordable electrical potential but with increase force of contraction, amplitude of potential increases
- An electromyography detects electrical potential generated by muscle cells when these cells are electrically or neurologically activated

Equipment

- **Electrodes**
  - Surface electrodes
  - Needle electrodes
- **A high gain amplifier**
- **Connected to an oscilloscope**
  - Oscilloscope traces may be photographed or stored on magnetic tape
- EMG signals may be fed to an audio unit for an on the spot feel of the signals
- EMG is best done in especially constructed shield room to prevent interference

Needle Electrode



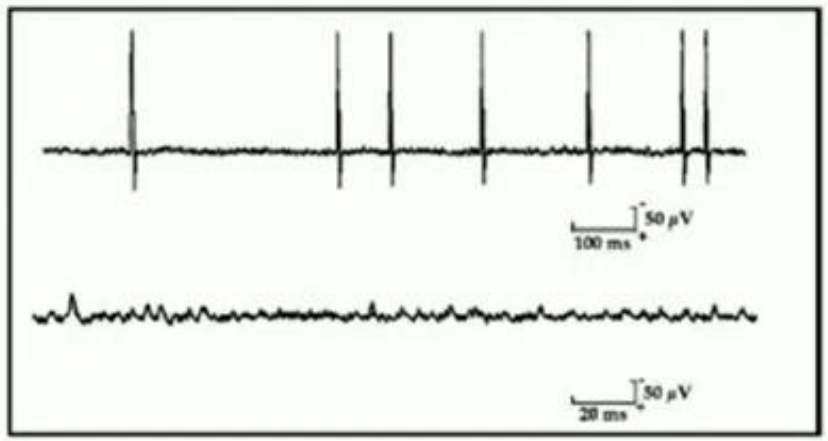


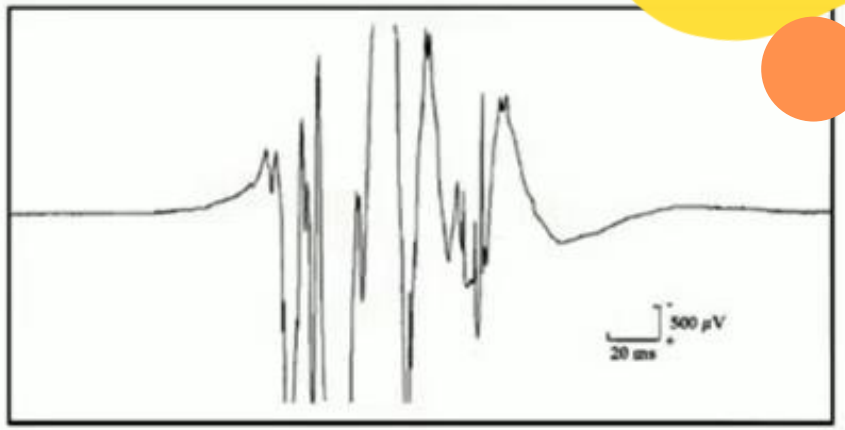
Surface Electrode

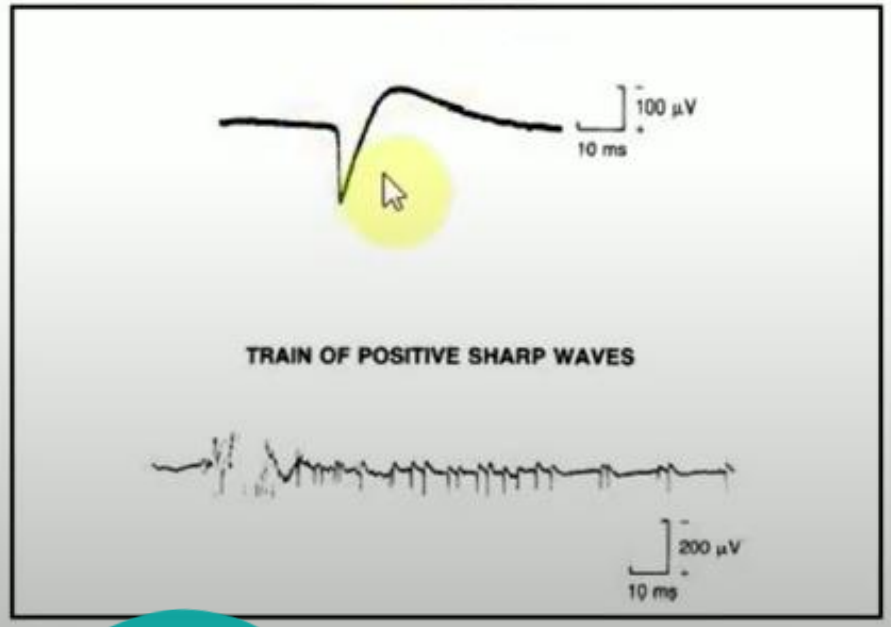
In general, three different parameters can be determined by electromyography:

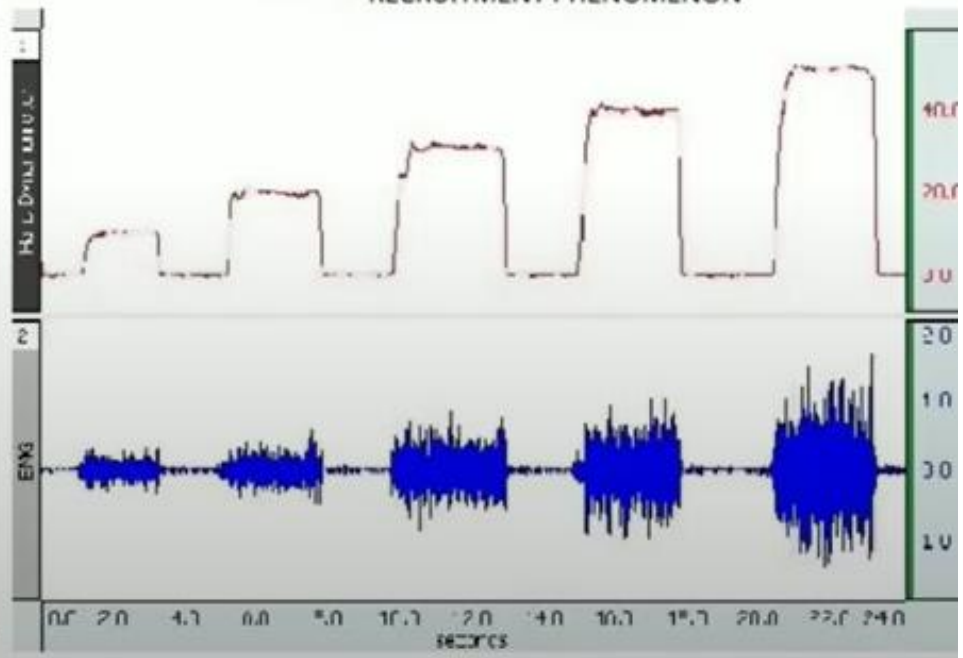
- **Timing – when is a muscle activated?**
- **Force – How strongly does a muscle contract?**
- **Fatigue – Can a muscle call up its full power?**

Pattern of EMG	Recorded	Findings
Resting activity	Muscle relaxed & needle not moving	No activity
Insertion activity	Needle is moved to various sampling spots within insertion tract	Brief action potentials
Motor unit potential	Needle is not moved while patient makes slight contraction	A few motor unit action potentials, biphasic or triphasic, short duration
Recruitment	Subject makes progressively stronger muscle contraction until reaching	Increase number of functioning movements until the baseline is obscured


RESTING EMG
50 µV
100 ms
50 µV
20 ms

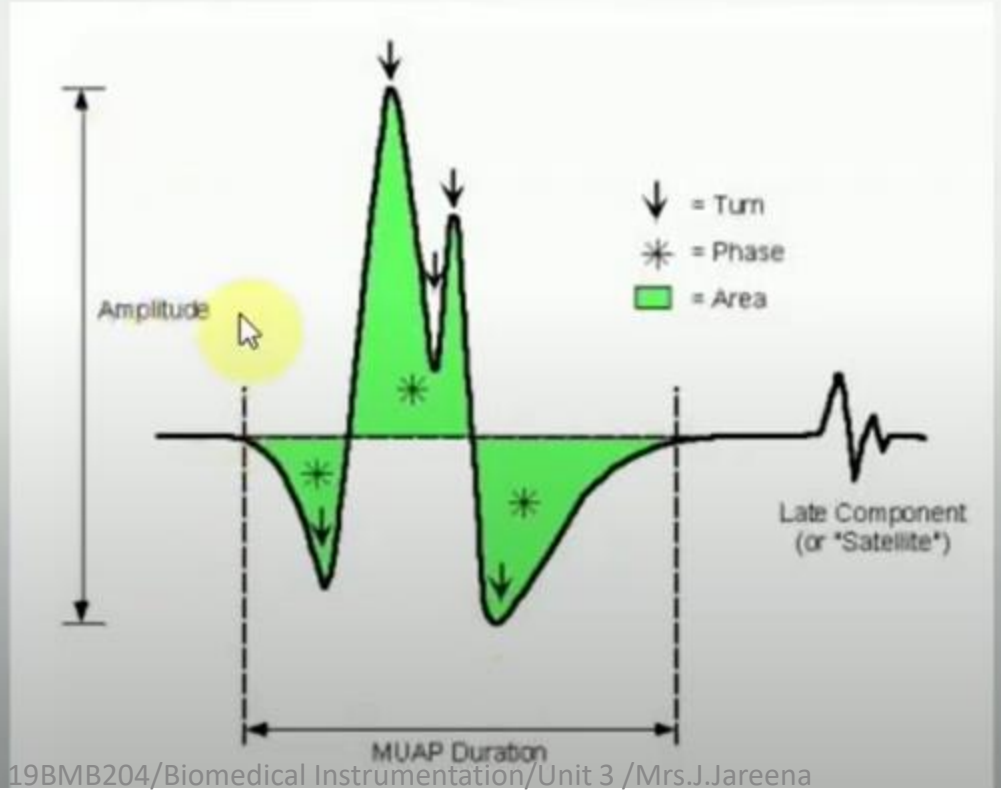

INSERTION ACTIVITY
500 µV
20 ms


Motor Unit Potential (MUP)
100 µV
10 ms
TRAIN OF POSITIVE SHARP WAVES
200 µV
10 ms


RECRUITMENT PHENOMENON
EMG

Motor unit potential (MUP)

- The sum of the action potentials produced in the muscle fibers stimulated by single motor neuron
- Characterized by its duration, number of phases, amplitude, & rate of rise of first component



Feature of MUP	
Duration	• measured from the initial take-off to the point of return to the baseline • 5-15 ms
Phases	• portion of the MUP between the departure & the return to the baseline • triphasic (positive, negative, positive) • Polyphasic-MUP with more than four phase (5-15%)
Amplitude	• measured from maximum peak of negative phase to maximum peak of the positive phase • 0.5mV to 2mV
Rise time	• duration from the initial positive to subsequent negative peak • normal ↓ 500 µs

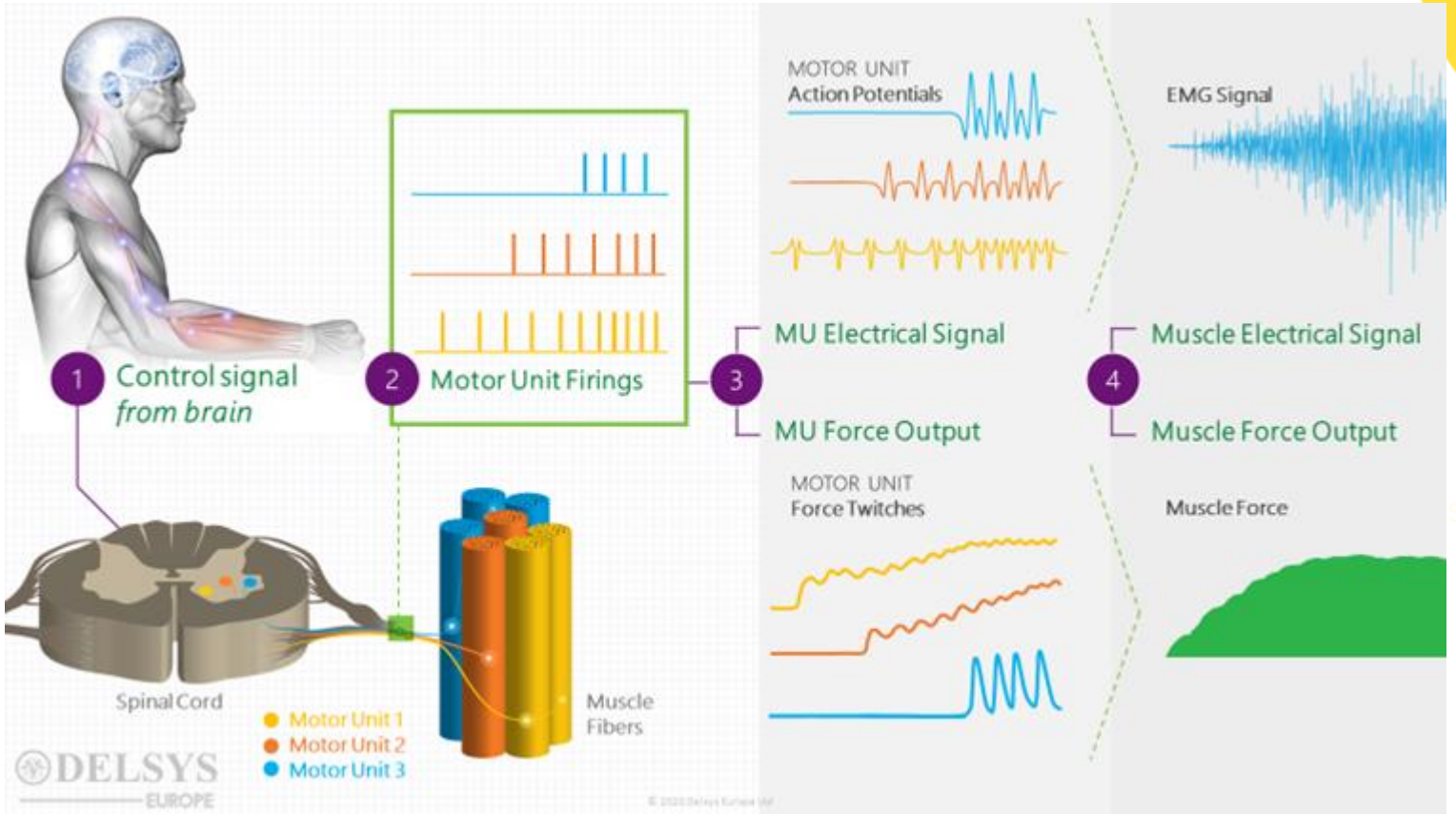
Factors that effect MUP

- Technical factors
  - Type of needle electrode
  - Characteristics of recording surface
  - Electrical characteristics of cable
  - Preamplifier & amplifier
  - Method of recording

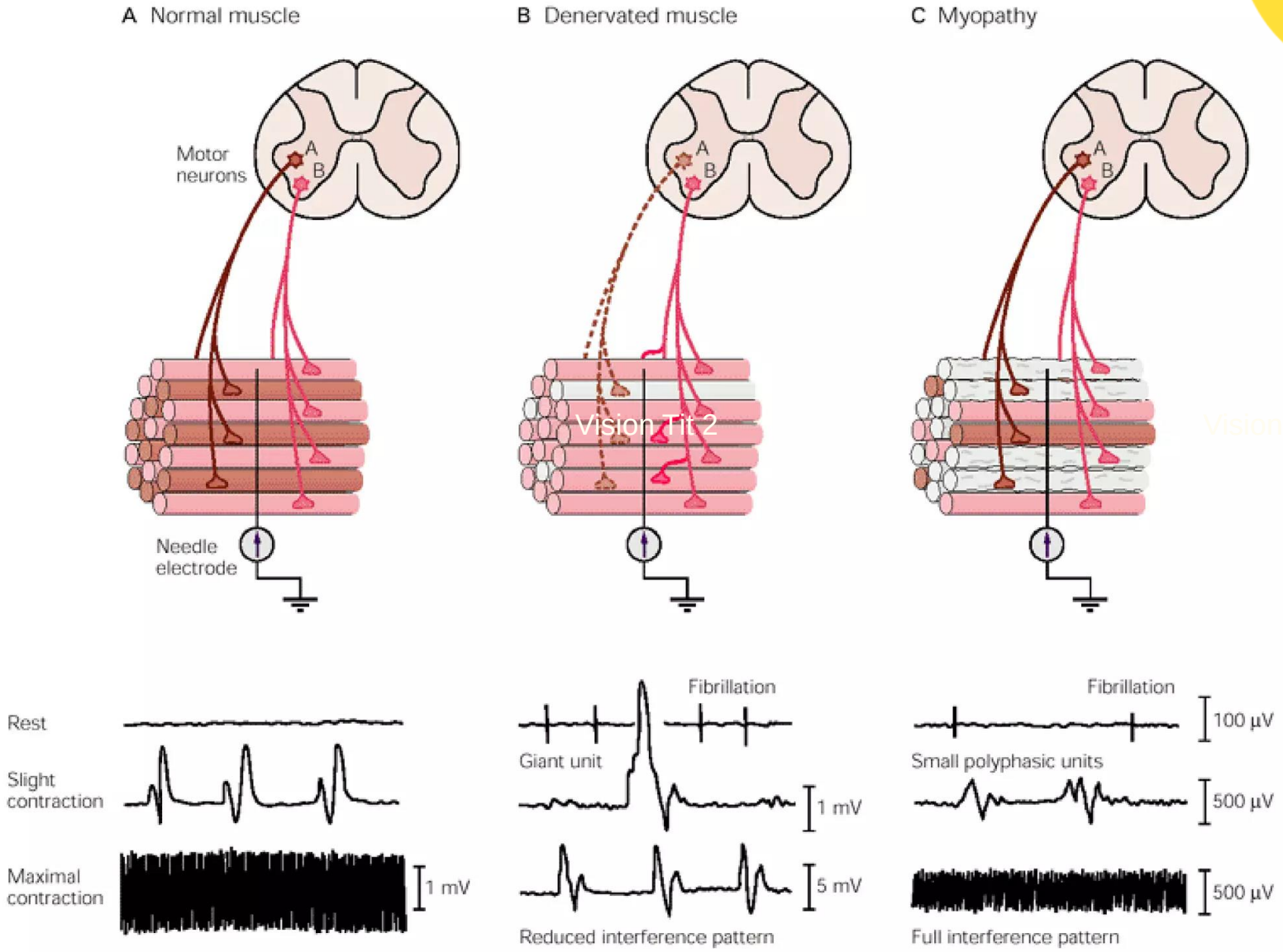
- Physiological factors
  - Age of the patient
  - Muscle examined
  - Temperature

Analysis of EMG Waveform

- **Qualitative** – visual inspection (Size, shape and morphology of EMG signal
- **Quantitative** – Quantitative information about EmG signal
  - Amplitude of signal
  - Frequency response of the EMG
  - Time Duration
  - Power spectrum



1) The initial control signal to contract a muscle arrives from the brain in the spinal cord. 2) Signal gets transmitted to several motor units. 3) The signal arrives at the muscle and is transformed to a MUAP. The muscle contracts and produces a muscle force. 4) Superposition of individual MUAPs and their sum as the resulting EMG signal. The sum of MUAPs determines the total muscle force.



Vision Tit 2

Vision Title 3

Applications of EMG

Medical Research

- Orthopedic
- Surgery
- Functional Neurology
- Gait & Posture Analysis

Rehabilitation

- Post surgery/accident
- Neurological Rehabilation
- Physical Therapy
- Active Training Therapy

Ergonomics

- Analysis of demand
- Risk Prevention
- Ergonomics Design
- Product Certification

Sports Science

- Biomechanics
- Movement Analysis
- Athletes Strength Training
- Sports Rehabilitation