LECTURES 9-10: TECHNOLOGICAL ADVANCEMENTS IN PROSTHETICS

9.1 Introduction

The decision to get a prosthetic replacement limb represents a major step forward for an individual ready to continue life and pursue his or her dreams.

In the world of prosthetics, function is king, and most amputees are constantly searching for the level of function they enjoy before they lose their limb. With the introduction of micro-processor-controlled limbs, amputees are closer to their goals than ever before.

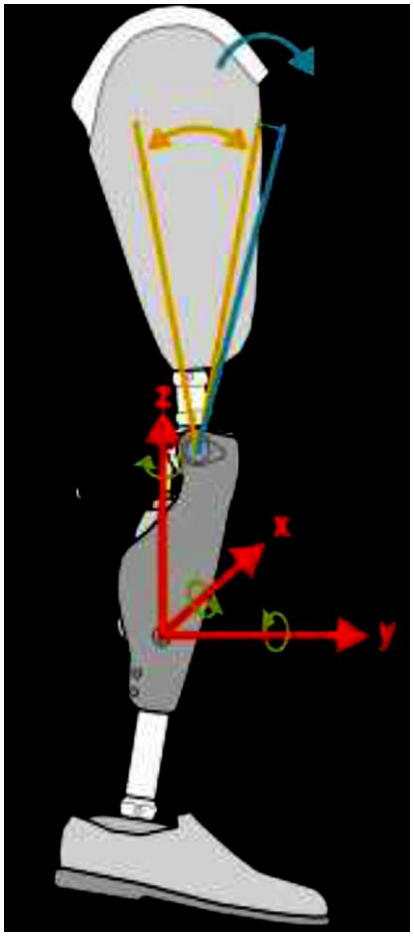
Advanced technology has greatly benefited the field of prosthetics in the last few years. Today's prosthetic limbs are made of space-age materials that increase durability and function. The result is that prostheses today can be as much lighter than prostheses made even just 5-10 years ago.

In addition, many prosthetics make use of bionic technology. These types of prosthetics are called myoelectric prosthetics.

The **computer technology** in these types of prosthetics has helped thousands of amputees return to daily activities that they never dreamed possible again. Physically challenged patients are now able to return to most all activities – gardening, running, golfing, fishing … whatever they wish to do.

Prosthetic technology today offers artificial limbs with significantly improved function. This type of prosthesis offers tremendous results. The computer chip reads each step and then applies the resistance needed instantaneously to the pneumatic knee unit. With the introduction of micro-processor-controlled knee systems, most amputees

can achieve the level of function they enjoyed before amputation. For many, the C-Leg is proving to be an excellent solution.



9.2 Microprocessor Controlled Knee

- **Built-in acceleration sensors and gyroscope**
- **Parameters measured:**
  - **Knee angle and angular velocities, extension moment, linear acceleration, orientation of shank in space, etc.**
- **Adjust joint movement on a real-time as-needed basis**

9.3 Latest Developments

- **Optimized physiological gait**
- **Improve balance & reduce risk of fall**
- **Improve slope- and stair-walking ability**
- **Walking speed**
- **Sports mode**
- **Training mode**
- **Waterproof**

9.4 Transtibial Amputee

- **High level of mobility**
- **Less demand on mechanical/ electronic ankle joint**
- **Foot and ankle complex**

- **Performance over safety**

9.5 Microprocessor Controlled Ankle Joint

- **Amputee who are low to moderately active (K2-3 level) and want to maintain an active lifestyle.**
- **Provide powered propulsion**
- **Automatically adjust the plantar flexion angle**

- **Faster walking speed**
- **Reduce energy expenditure**
- **More natural gait**

9.6 Sports Prostheses

- **Advancements in technology help to create prostheses adapting the different features of sports**
- **Factors to be considered: component selection, weight of prosthesis, energy rebound capacity, suspension, shock dampening, skin friction, etc.**
- **Sports: running, dancing, diving, cycling, golf, skiing, etc.**

9.7 Roles of Prosthetist

- **Prosthetic prescription**
- **Biomechanical consideration in socket design**
- **Socket/skin interface**
- **Calibration of electronic components**
- **Dynamic alignment setting**
- **Sports mold setting**
- **Gait training**
- **To maximize the functions of the prosthesis to fit the needs/activities of individual amputee**

9.8 Materials Science and Technology

- **Carbon fiber**

  - Thin, lightweight but strong prosthetic socket

  - Foot and ankle complex with excellent rebound capability

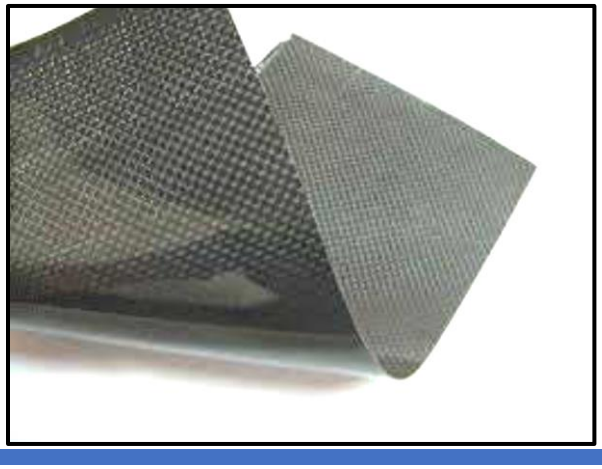
- **Gel liners as socket interface:**

  Thermoplastic elastomer, Polyurethane and Silicone

  - Cushioning and evenly distributing the pressure

  - Reduce skin friction and avoid breakdown when playing vigorous activities

  - Suspension



9.9 Upper Extremity Amputee

- **Complexity of hand function**
- **High dropout rate, especially body power control hand user (mechanical)**

"53% of dropout rate of paediatric myoelectric hand users" (Routhier 2001)

- **Prevalent practice is fitting of cosmetic Hand**

9.10 Modern Advances in Prosthetic Technology

Modern prosthetic devices are made using advanced plastic and carbon fiber composites. These materials make the limb much lighter yet stronger and look more realistic. With the help of electronic technology, prosthetics in today's world give the user more control.

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Modern prosthetic devices are capable of automatically adapting their functions in performing certain tasks, namely holding something or walking. The prosthetic can also be custom made and look however you choose. You can even accessorize it with a favorite sports team's logo, your favorite color or even a designer style. The prosthesis can be designed to reflect your unique personality.