SOLUTIONS FOR ERGONOMICS IN HIGH LEVEL AMPUTATION TREATMENT
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ABSTRACT & INTRODUCTION
The needs of above elbow amputees vary a lot depending on the level of amputation and the patient’s physical and mental abilities. Eliminating the hassle of a harness for a body powered elbow lock has always been a very tempting idea. Especially if the price you have to pay for this is not as high as the weight of a fully electrified elbow joint. Yet the success of such a fitting depends very much on the controllability of the lock. Furthermore a low level of noise is as essential as an instantaneous activation of the lock.

This presentation will give you an idea of the possibilities which a new high-tech electronically controlled lock offers to optimize high-level myoelectric fittings. Furthermore, it will explain different control options which allow an adaptation to the individual needs and capabilities of the patient.

ERGOARM ELECTRONIC PLUS 12K50
The ErgoArm Electronic plus provides additional functional possibilities, enabling the prosthetist to do high level fittings in some cases even without the need for a harness. Its unique electronically controlled lock is the heart of this high-tech device. Controlled by signals coming from a myo electrode or a switch, a tiny but powerful drive unit locks or unlocks the elbow joint instantly within milliseconds. An important development goal was to make the locking/unlocking process as quiet as possible. The unique rigid but light weight design eliminates unwanted noise successfully, so that in everyday environment the locking and unlocking can hardly be heard.

Figure 1 – Electronic controlled elbow lock
Control Options

Seven different control schemes allow the choice of an optimal solution for the individual amputee. These schemes are easily activated by means of small colored coding plugs. No computer is needed, as thanks to microprocessor technology the “Patient-Machine interface” has been optimized to meet the demands of most patients. In addition, this saves the prosthetist’s time as there is no need for time consuming PC adjustments.

After the battery is inserted into the prosthesis the current switching mode will be indicated by a vibration feedback signal. For the safety of the patient the ErgoArm Electronic plus also includes a mechanical (un)locking possibility if the battery runs empty: A pull cable which can be attached to the socket.

The ErgoArm Electronic plus may be controlled by means of electrodes, switch or a combination of electrode or switch. These are the available control schemes:

Switch:
1. Actuating the switch alternately locks or unlocks the elbow joint

Electrodes:
2. A Co-contraction alternately locks or unlocks the elbow joint
3. Make a Co-contraction to get into elbow mode. Now signals from one electrode lock the elbow joint as the other one unlocks it. Co-contract again to leave elbow mode
4. As 3., but leaves elbow mode automatically if there is no signal within 10 seconds.

Switch and Electrodes:
5. As long as the switch is actuated the control is in elbow mode. Now signals from one electrode lock the elbow joint as the other one unlocks it. Release the switch to leave the elbow mode.
6. Actuated the switch to get into elbow mode. Now signals from one electrode lock the elbow joint as the other one unlocks it. Actuate the switch again to leave elbow mode.
7. As 6., but leaves elbow mode automatically if there is no signal within 10 seconds.

Slip-Stop

A unique feature of the ErgoArm, the Slip-Stop function for a controlled lowering of the forearm, has also been integrated into the electronically controlled lock: If the control is in elbow mode (3., 4., 5., 6., 7.) a small signal on the opening electrode releases the lock temporarily.
Once the signal drops, the elbow locks instantly. Slip-Stop makes it easier for the patient to exactly position the forearm.

**ErgoArm Family of Elbows**
Together with the ErgoArm Electronic plus there is now a family of 4 different ErgoArms. Every ErgoArm version fits the demand of a certain fitting option.

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Figure 3 - ErgoArms

All of them are based on the same sturdy and light weight construction. This improves reliability and makes it easy to handle them.

**ADAPTER 13Z68**
The Adapter allows the easy connection of any ErgoArm to a prosthesis which was built for use with a Hosmer elbow joint. After screwing the Adapter on, the ErgoArm is ready to be connected for evaluation or replacement.

**LINEAR TRANSDUCER**
Another important solution for high level amputation treatment is the Linear Transducer. If integrated into a harness system, this device transforms the patient’s body movement into proportional electric signals. This signals can be used to proportionally control an electric device.
such as an electric hand, an electric Greifer or an electric elbow joint.

CONCLUSION

Higher amputation levels have less possibilities to control a prosthesis whilst the need for additional functions is increasing. Therefore the treatment of high level amputations has always been a special challenge. Technological progress such as the introduction of microprocessors in the field of upper extremity prosthetics lead to new innovative components. These provide new solutions for ergonomics in high level amputation treatment.