USING DIAGNOSTIC ULTRASOUND FOR FITTING MYOELECTRIC PROSTHESIS IN INFANTS WITH CONGENITAL UPPER LIMB DEFICIENCY

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ABSTRACT

When fitting an infant with the first myoelectric prosthesis, finding an appropriate location and orientation for the myoelecrode to gain adequate signal at muscle contraction is troublesome.

Palpating the small muscle bulge in the short residual limb at short contraction without interactive communication is not easy and searching the location on the arm moving the sensor while watching the myoelectric signal on the screen is an overloaded task.

Diagnostic ultrasound B-mode image is a convenient and safe technique to visualize normal and pathological muscle and other anatomical variety in real-time in a non-invasive manner.

Since 2017, we are successfully using ultrasound diagnostic device (UD) for arranging the electrodes. UD is effective and useful at practice situation, since the dynamic visual feedback of the muscle contraction allows to easily and reliably locate the electrode location over the target muscle.

Diagnostic ultrasound should also be a good visual feedback system to train or detect proper signal strength from limb deficiency patients.

BACKGROUND

Congenital upper limb deficiency (CULD) is a rare disease which impairs both function and appearance of the limbs. The treatment approaches vary according to the type of deficiency. To provide better evidence-based medical care, it is necessary to establish the standard treatment of CULD. (1)

We established Limb Differences/Amputee Clinic since 2013. This outpatient clinic is not only for adult patients but also for children with congenital and acquired amputations or limb deficiencies. Our team members include rehabilitation physicians, occupational therapists, physical therapists, prosthetists, engineers and other comprehensive care members such as orthopaedic surgeons and paediatricians

We provide rehabilitation therapy including prosthetic interventions, such as conventional prostheses, myoelectric prostheses and so on.

Since 2017, we had started using Ultrasound diagnostic device (UD). UD is a convenient and safe technique to visualize normal and pathological muscle and other anatomical variety as it is not invasive and real-time. When fitting an infant with the first myoelectric prosthesis, we need to find an appropriate place for the myoelecrode to get a proper signal when the muscle is contracted.

The prescription of prostheses and proper fitting of a prosthesis require an adequate length of the stump. However with infants with short stump of transradial deficiency, we always have trouble finding an appropriate location and orientation for the myoelecrode to gain adequate signal at muscle contraction is troublesome.

Palpating the small muscle bulge in the short residual limb at short contraction without interactive communication is not easy and searching the location on the arm moving the sensor while watching the myoelectric signal on the screen is an overloaded task. UD is so convenient and useful at practice situations because we can place an electrode on the exact muscle inside of the infant's short stump with assurance.

CASE PRESENTATION

The subjects are three infants before 2-year-old of age with transradial limb deficiencies in the short residual limb with the first myoelectric prosthesis. (Fig.1)

When we prescribe and fit an infant with the first myoelectric prosthesis, finding an appropriate and suitable place for the electrode to get a proper signal is required when the the small muscle bulge of stump is contracted.

We use the diagnostic ultrasound system SNiBLE by Konica Minolta or finding appropriate muscle in the stump. Diagnostic ultrasound B-mode image is a convenient and safe technique to visualize normal and pathological muscle and other anatomical variety such as joint instability or laxity and muscle deficiency in real-time in a non-invasive manner.

finding an appropriate location and orientation for the electrode to gain adequate signal at muscle contraction is troublesome. It is often happening and we face the difficulty that finding the appropriate location and orientation for the electrode without interactive communication. This is because of the small muscle of residual limb and the thick subcutaneous fat. However, UD is an effective and useful device at practice situation such as the infant with a short stump of transradial deficiency, because we can find the place an electrode on the exact muscle in the short residual limb of the infant with assurance. The information and data from UD is not only reveals the presence of the muscle but the direction of muscle fiber as well. (Fig.2)

When fitting a toddler or young child with a myoelectric prosthesis, it is said that finding appropriate muscle sites to place an electrode is generally easy.（2） However it is not so easy with an infant around age 0 to 1-year-old who has the short residual limb. Finding small muscle bulge and direction of muscle fiber is nearly impossible to find on the infant residual limb because it is too small and difficult to see, due to no functional motion of the joint and thickness of subcutaneous fat.

Using diagnostic ultrasound B-mode image is effective technique for us to place the electrode on the infant small stump. All the three infant with short residual limb are easily successed the site selection, and they control with sure and good to operate the myoelectric.

CONCLUSION

The infant with a short residual limb of transradial deficiency, we always have trouble to find the ideal place for the electrode. It is also said that UD appeared to be more sensitive in detecting EMG and clinical observations, because it can visualize a large muscle area and deeper located muscles. (3)

We had started using UD. It is so convenient and useful at practice situations because we can place an electrode on the exact place of the muscle inside the infant short residual limb. This is where we can place the electrode by diagnostic ultrasound without a doubt or hesitation if the infant cannot contract the muscle in the short residual limb during site selection to control myoelectric.

Furthermore, the child can see their muscle contraction or movement by UD, we are confident that diagnostic ultrasound also becomes a good visual feedback system to train or detect proper signal strength from affected limb for young children and older who can recognize the image.

This report was approved by the Ethics Committee of the Faculty of Medicine of the University of Tokyo ; ethical approval number: 2373. At the University of Tokyo Hospital, all patients were given an explanation regarding personal information protection, including the use of clinical data for research.

FIGURE

Figure 1: Right transradial CULD short stump of 1-year old girl.

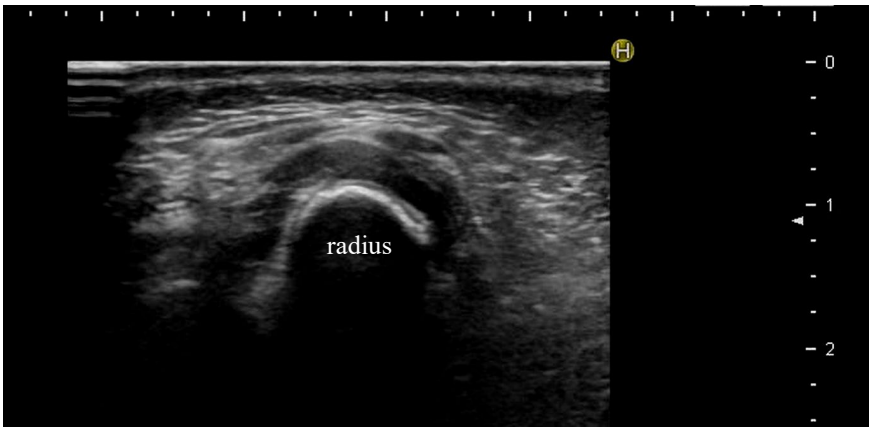

Figure 2: Cross section of CULD proximal stump by UD. Supinator muscle and other extensor muscles on the radial side of forearm. The UD can detect and visualise the muscle less than 2mm thickness.

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