شرکت فناوری سامانه های الکترونیک عصبی

PARAWALK®

پروتز عصبی گام برداشتن پاراواک®

ایستادن و گام برداشتن افراد دچار ضایعه نخاعی با پاراواک

ساخت ایران

محصول دانش بنیان
بیش از ۲۰ سال تلاش علمی پژوهشی

دارای مجوز از اداره کل تجهیزات پزشکی، وزارت بهداشت و درمان

پاراواک®

گام برداشتن افراد فلج کامل دو پا با استفاده از فناوری عصبی

شرکت فناوری سامانه های الکترونیک عصبی

افرادی که دچار ضایعه نخاعی هستند علاوه بر مشکلات حرکتی، در اثر عدم تحرک دچار عوارضی از قبیل پوکی استخوان، آتروفی عضلانی، سفتی مفاصل، نارسائی‌های کلیوی و قلبی-عروقی می‌شوند. همچنین، این افراد کنترل ادرار ندارند و عمل دفع آنها با مشکل مواجه است. علاوه بر عوارض فوق، این افراد دچار افسردگی می-شوند و نگه‌داری این افراد برای خانواده مشکل و دارای هزینه است. لذا همواره دست یابی به روشی برای رفع معلولیت و عوارض ناشی از آن، هدف بسیاری از تحقیقات را تشکیل داده است.

تا کنون برای اِیجاد حرکت در افراد فلج روش‌های مختلفی مطرح شده است. یکی از روش های مرسوم استفاده از اسکلت‌های رباتیک است. این ربات‌ها بر روی عضو فلج قرار می‌گیرد و باعث حرکت پسیو در عضو می‌شود. از روش‌های رایج دیگر برای ایستادن شخص معلول و ایجاد تحرک استفاده از وسایل مکانیکی چون ویلچر ایستا است. این وسایل، تحرک بسیار محدود در عضو ایجاد می‌کند. از همه مهمتر حرکت ایجاد شده پسیو است. روش دیگر مبتنی بر بازسازی اعصاب صدمه دیده است. این روش هنوز در مرحله تحقیقات بنیادین است و به محیط‌های کلینیکی راه پیدا نکرده است.

از روش‌های مطرح و موثر برای رفع مشکلات حرکتی در افراد دچار ضایعه نخاعی، قطع نخاع صدمات مغزی، افراد دچار CP، MS و stroke، مهندسی عصبی است. مهندسی عصبی از حوزه‌های گسترش یافته در قرن ۲۱ در زمینه مهندسی پزشکی است. **از** اهداف مهندسی عصبی پی بردن به سازوکار عملکرد سیستم های عصبی حسی و حرکتی با استفاده از روش‌های مهندسی و ارائه مدل‌های ریاضی از سیستم عصبی در سطوح مختلف است. مهندسی عصبی منشأ ایجاد یک فناوری، تحت عنوان فناوری عصبی شده است. هدف این فناوری، طراحی و ساخت ابزار میکروالکترونیکی عصبی با کنترل تراشه‌های ریزپردازنده‌ائی (تراشه های عصبی) است که با ارتباط مستقیم با سیستم عصبی مرکزی و یا اعصاب محیطی، کنترل خارجـــی ارگان های بدن را به عهده می‌گیرد.

یک تیم تحقیقاتی در پژوهشکده مهندسی و فناوری عصبی ایران، دانشگاه علم و صنعت ایران، پس از ۲۵ سال تلاش موفق به طراحی و ساخت یک سیستم عصبی منحصر بفرد تحت عنوان پاراواک (ParaWalk) برای ایجاد و کنترل حرکت در افراد دچار ضایعه نخاعی شده‌اند. تا کنون بیش از ۲۰۰ مقاله در داخل و خارج از کشور توسط پژوهشگران پژوهشکده مهندسی و فناوری عصبی در راستای پروتزهای عصبی به چاپ رسیده است.

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پاراواک چیست؟

پروتز عصبی حرکتی پاراواک یک سیستم های میکروالکترونیکی با کنترل تراشه ریزپردازنده-ای است که بر مبنای سیستم عصبی مرکزی انسان، حرکت را در عضو ایجاد و کنترل می‌کند. این سیستم قابلیت برنامه ریزی حرکتی را دارد، و با توجه به حرکت مورد نظر، میزان انقباض را در طول حرکت کنترل می‌کند. سیستم پاراواک با بکارگیری مدل‌های ریاضی از سیستم‌های اسکلتی-عضلانی و استراتژیهای کنترلی، میزان انقباض عضلات فلج را در طول حرکت کنترل می کند.

کاربردهای پاراواک

سیستم عصبی پاراواک برای ایجاد حرکت‌های ایستادن، گام برداشتن، و نشستن بعضی از افراد دچار ضایعه نخاعی کامل در سطح کمر بکار می‌رود. علاوه بر کاربردهای حرکتی، سیستم پاراواک دارای کاربردهای درمانی بوده و از پوکی استخوان، آتروفی عضلانی، و زخم بستر جلوگیری می‌کند و باعث بهبود در وضعیت قلبی-عروقی، عملکرد سیستم گوارش بیمار می شود. تا کنون سیستم پاراواک بر روی افراد پاراپلژیک مورد ارزیابی قرار گرفته شده است بطوریکه این افراد، قادر به ایستادن و بطور محدود قادر به گام برداشتن شده‌اند.

علاوه بر کاربردهای بالینی، سیستم پاراواک برای کاربردهای تحقیقاتی قابل استفاده است. سیستم از طریق کابل USB با کامپیوتر قابل اتصال بوده و یک نرم افزار گرافیکی امکان برنامه ریزی حرکتی را مطابق با وضعیت بیمار فراهم می‌کند.

چه کسانی می توانند از پاراواک استفاده کنند؟

قبل از بکارگیری پروتز عصبی، بر روی هر شخص پاراپلژیک، پارامترهای خاصی از وضعیت فیزیکی، و شرایط روحی و ذهنی وی باید مورد ارزیابی قرار گیرد و باید بیمار دارای شرایط خاصی باشند: حداقل شش ماه از مدت ضایعه گذشته باشد؛ سطح ضایعهٔ T4 تا T12؛ عدم آسیب در اعصاب محیطی پایین؛ دارای شرایط خوب فیزیکی؛ دارای ضربان، فشار خون و وضعیت تنفسی طبیعی؛ دارای پایداری کافی در تنه؛ قابلیت کنترل دست جهت کمک به ایستادن و نگه داشتن واکر، داشتن قابلیت عملکرد انگشتان جهت کنترل کلیدهای سیستم؛ عدم داشتن osteoporosis؛ داشتن انگیزه؛ و غیره. در دفتجه راهنمائی سیستم بطور دقیق شرایط پذیرش بیمار آورده شده است. به منظور استفاده از پاراواک، و حصول نتیجه لازم است طبق دستورالعمل دفترچه راهنما عمل شود.

ایستادن و گام برداشتن آقای رضا رمضانی با استفاده از پروتز عصبی پاراواک، نامبرده در سال ۱۳۷۶ در اثر تصادف دچار ضایعه نخاعی در سطح T7 بطور کامل می‌شود و هر گونه حس و حرکتی را در اندام تحتانی خود از دست می‌دهد (فلج کامل دو پا). در حال حاضر با استفاده از پاراوک بدون استفاده از بریس قادر به بلند شدن از ویلچر، ایستادن، نشستن از موقعیت ایستاده و گام برداشتن شده است. وی از واکر برای حفظ تعادل خود استفاده می‌کند، حرکت در اندام با کنترل انقباض عضلات توسط سیستم پاراواک انجام می شود.

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آقای حمید دهقان در اثر تصادف در سال ۱۳۸۷ دچار ضایعه نخاعی در سطح c7 می‌شود. وی پس از تمرینات لازم با استفاده از پروتز عصبی پاراواک بطور محدود قادر به ایستادن و گام برداشتن بدون بهره گیری از بریس شده است.

آقای مهیار صحی در سال ۱۳۸۰ هنگام ورزش دچار ضایعه نخاعی در سطح T10-T11 می‌شود. وی در حال حاضر با استفاده از پروتز عصبی پاراواک، بخوبی قادر به بلند شدن، ایستادن، نشستن و گام برداشتن است. وی ابراز می‌دارد از زمانیکه وارد برنامه درمانی شده است، کاهش اسپاسم قابل ملاحظه‌ای داشته، عضلات اندام تحتانی او سفت‌تر شده و احساس استحکام در استخوان‌های اندام تحتانی دارد.

آقای امید امامی متولد سال ۱۳۶۰ و متاهل در سال ۱۳۹۴ در حادثه رانندگی در ناحیه T10-T11 دچار آسیب نخاعی شده است. وی پس از ده جلسه تمرین به صورت یک جلسه در هفته موفق به جدا شدن از صندلی چرخدار و ایستادن شد و پس از ۲ ماه تمرین هفتگی به مرحله گام برداشتن رسید. هم‌اکنون به راحتی بدون استفاده از بریس با کمک دستگاه پاراواک گام برمی‌دارد.

آقای میثم سنگین آبادی در سال ۱۳۹۱ در هنگام شنا، دچار آسیب در ناحیه T3 نخاعی می‌شود. وی در کمتر از چهار جلسه تمرین با کمک استفاده از دستگاه پاراواک، بدون استفاده از بریس قادر به ایستادن و گام برداشتن شده است.

آقای علیرضا آقابابایی در سال ۱۳۹۰ در اثر بیماری عفونی نخاع حس و حرکت خود در اندام تحتانی را از دست داد. وی هم اکنون با کمک پروتز عصبی پاراواک گام بر می‌دارد.

آقای میلاد مهاجری در سال ۱۳۹۱ در اثر سانحه رانندگی در ناحیهT10-T11 دچار آسیب شدید نخاعی شد. او پس از ۱۰ جلسه تمرین موفق به راه رفتن با پروتز عصبی پاراواک شد.

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رونمائی پاراواک توسط معاون علمی و فناوری ریاست جمهوری و وزیر بهداشت

بازدید معاون علمی و فناوری ریاست جمهوری و معاونین از پاراواک

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شرکت فناوری سامانه‌های الکترونیک عصبی

بازدید معاون پژوهشی سابق وزارت بهداشت

و رئیس سابق اداره نظارت و تولید و کنترل کیفی اداره کل تجهیزات پزشکی

بازدید هیات آلمانی از نتیجه تحقیقات پاراواک

بازدید رئیس سابق دانشگاه علوم پزشکی شهید بهشتی و آقای دکتر زالی رئیس نظام پزشکی از پاراواک

بازدید آقای دکتر فرهادی از پاراواک

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ایمیل: intc@iust.ac.ir

http://intc.iust.ac.ir/

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شرکت فناوری سامانه های الکترونیک عصبی

NeuroTekTronix, Inc.

ParaWalk®

Neural Technology

Standing and Walking in Paraplegic Subjects

Made In IRAN

ParaWalk®

The ParaWalk is a new portable, 8-channel, and menu-driven microprocessor controlled functional neuromuscular stimulation (FNS) that enables complete paraplegic subjects with upper motor neuron lesion and some incomplete paraplegics to stand from a sitting position, walk short distance, and sitting from standing position unbraced with the support of a walker, following a prescribed period of physical therapy training under aggressive assessment and rehabilitation management of subject with spinal cord injury.

The ParaWalk can be also used for a wide range of therapeutic electrical stimulation applications. The purpose of therapeutic electrical stimulation is to improve tissue health or voluntary function by inducing physiological changes that remain after the stimulation is used. In contrast, the purpose of an FNS intervention is to enable function by replacing or assisting a person's voluntary ability.

Functional, Physiological, and Psychological Effects

The ParaWalk® enables complete paraplegic subjects with upper motor neuron lesion and some incomplete paraplegics stand from a sitting position, walk short distance, and sitting from standing position unbraced, with the support of a walker and assistance if required, following a prescribed period of physical therapy training under aggressive assessment and rehabilitation management of subject with spinal cord injury. The functional applications of the ParaWalk® may include:

- ⇒ standing from a sitting position,
- ⇒ walking short distance,
- ⇒ sitting from standing position unbraced

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Moreover, the ParaWalk can be used for a wide range of therapeutic electrical stimulation applications. The purpose of therapeutic electrical stimulation is to improve tissue health or voluntary function by inducing physiological changes that remain after the stimulation is used. In contrast, the purpose of an FNS intervention is to enable function by replacing or assisting a person's voluntary ability. Therapeutic applications of the ParaWalk® may include:

- ⇒ Increase muscle bulk and strength in the lower extremities
- ⇒ Slow osteoporosis and help maintain or increase lower extremity joint range of motion
- ⇒ Reduce risk of decubitus ulcers
- ⇒ Aid bowel and bladder function
- ⇒ Improve circulation in the legs
- ⇒ Improve cardiovascular health
- ⇒ Reduce spasticity
- ⇒ Increase in Physical self-concept and a decrease in depression
- ⇒ Improve fitness

How does Parawalk® work?

In the Parawalk® system, sequences of current pulses excite the intact lower motor neurons, which in turn contract paralyzed muscles. Activation of the lower motor neurons is achieved using electrodes placed on or near the innervating nerve fibers. By changing the parameters of the stimulation signal, the level of contraction can be altered to perform a specific task. To provide functional use of the paralyzed limbs, an appropriate electrical stimulation pattern should be delivered to a set of muscles.

Any arbitrary stimulation pattern can be generated by the ParaWalk. The stimulation pattern can be designed using a graphic user interface (GUI) running on a personal computer (PC) and transferred to the ParaWalk through USB cable. The system uses pulse width modulation to regulate the stimulated muscle force. The ParaWalk provides on-line monitoring of functional operation of the system and electrode lead connection, and appropriate visual and audible alarm indicate the fault condition.

Who can benefit from Parawalk®?

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The Parawalk® is designed for standing and walking of some certain paraplegic subjects with a complete traumatic spinal cord lesion between T4 and T12. Before instituting the ParaWalk for any paraplegic subject, certain parameters of his or her physical, mental, and emotional condition must be evaluated.

1. Status: 6 months post-recovery spinal cord injury and restorative Surgery (if any), or as determined by systems.
2. Stable ortho-neuro-metabolic systems.
3. Spinal Cord Injury at a level between T-4 and T-12.
4. Intact lower motor units (lumbar level L-1 and below).
5. Certain incomplete lumbar level SCI patients if the lesion is serve enough to prevent the patient from standing and ambulating.
6. No history of long bone stress fractures, osteoporosis, or severe hip or knee joint disease.
7. No history of cardiac or respiratory problems.
8. Adequate trunk stability so that once quadriceps are stimulated, the patient can hold his upper trunk upright while supporting himself with a walker.
9. Motivation: the patient demonstrates and expresses appropriate desire and commitment to training program.
10. The patient demonstrates appropriate muscle contractions in response to functional electrical stimulation.
11. Minimal or acceptance amount of spasticity.
12. Sensory perception of electrical activity is absent, or if minimal, is non- painful and acceptable to patient.
13. Standing tolerance: The patient has adequate fatigue tolerance to practice and perform standing and walking functions.
12. Balance and trunk control: patient has adequate balance and control skills to independently maintain an upright supported posture.
13. The patient must have adequate hand and finger control to manipulate the system control.
14. Sufficient upper body and arm strength to lift oneself and grasp chair when stimulation is stopped for any reason.
15. It is noted that patients with very labile blood pressure are subject to vertigo when practicing with FES, as stimulation contracts muscles in lower part of the body that are otherwise paralyzed, thus affecting circulation. Such patients may complain of dizziness and should be permitted to lie recumbent for a period of time. The rate of FES training should then be carefully monitored.

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NeuroTekTronix Inc.
Nramak, Hengam Street, Iran University of Science and Technology
Tehran, IRAN
Phone: +98-21-77240465
Fax: +98-21-77240253
Email: intc@iust.ac.ir
http://intc.iust.ac.ir/