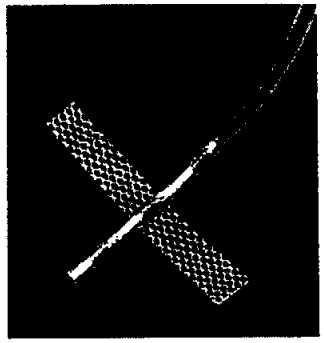

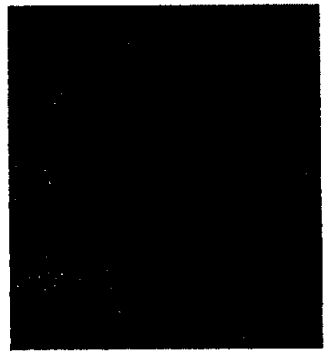

NeuroControl Corporation VOCARE Bladder System

Implantable Functional Neuromuscular Stimulator

PACKAGE INSERT

NEUROCONTROL CORPORATION

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Humanitarian Device. Authorized by Federal law for use in providing urination on demand with low residual volumes of urine to complete spinal cord injured individuals. The effectiveness of this device for this use has not been demonstrated.

Caution: *Federal Law restricts this device to sale by or on the order of a physician (or properly licensed practitioner).*

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DEVICE DESCRIPTION

The NeuroControl *VOCARE Bladder System* is a radiofrequency powered motor control neuroprosthesis which consists of both implanted and external components. The *VOCARE Bladder System* delivers low levels of electrical stimulation to a spinal cord injured patient's intact sacral spinal nerve roots in order to elicit functional contraction of the muscles innervated by them. The NeuroControl *VOCARE Bladder System* consists of the following subsystems:

- The **Implanted Components** include the Implantable Receiver-Stimulator and Extradural Electrodes.
- The **External Components** include the External Controller, External Transmitter, External Cable, Transmitter Tester, Battery Charger and Power Cord.
- The **Surgical Components** include the Surgical Stimulator, Intradural Surgical Probe, Extradural Surgical Probe, Surgical Test Cable, and Silicone Adhesive.

INDICATIONS FOR USE

The NeuroControl *VOCARE Bladder System* is indicated for the treatment of patients who have clinically complete spinal cord lesions (ASIA classification) with intact parasympathetic innervation of the bladder and are skeletally mature and neurologically stable, to provide urination on demand and to reduce post-void residual volumes of urine.

CONTRAINDICATIONS

The NeuroControl *VOCARE Bladder System* is contraindicated for patients with the following characteristics:

- poor or inadequate bladder reflexes
- active or recurrent pressure ulcers
- active sepsis
- implanted cardiac pacemaker

WARNINGS

The NeuroControl *VOCARE Bladder System* may only be prescribed, implanted, or adjusted by clinicians who have been trained and certified in its implementation and use.

Magnetic Resonance Imaging (MRI): Do not expose patients to MRI. There are potential effects of induced currents and radio frequency heating of the *VOCARE Bladder System* when exposed to magnetic fields and radio frequency fields associated with MRI systems which may result in patient injury.

PRECAUTIONS

X-rays, diagnostic ultrasound: X-ray imaging, and diagnostic ultrasound have not been reported to affect the function of the Implantable Receiver-Stimulator or Extradural Electrodes. However, the implantable components may obscure the view of other anatomic structures.

Therapeutic ultrasound, therapeutic diathermy, and microwave therapy: Therapeutic ultrasound, therapeutic diathermy, and microwave therapy should not be performed over the area of the Implantable Receiver-Stimulator or Extradural Electrodes as it may damage the *VOCARE Bladder System.*

Electrocautery: Do not touch the Implantable Components of the *VOCARE Bladder System* with electrocautery instruments. Do not use electrocautery within 1 cm of the electrode metal contacts.

Antibiotic prophylaxis: Standard antibiotic prophylaxis for patients with an implant should be utilized to protect the patient when invasive procedures (e.g., oral surgery) are performed.

Drug Interactions: Anticholinergic medications, or other medications which reduce the contraction of smooth muscle, may reduce the strength of bladder contraction achieved using the *VOCARE Bladder System.* Anticholinergic medications should be discontinued at least three days prior to evaluating patients for the *VOCARE Bladder System* and prior to implantation surgery so that bladder reflexes and response to electrical stimulation can be accurately evaluated. In addition, long-acting neuromuscular blocking agents must not be used during surgery.

Prior procedures (such as bladder neck surgery or bladder augmentation) ***or conditions*** (such as severe urethral damage, stricture, or erosion) may affect patient suitability for the *VOCARE Bladder System* or clinical outcome. Patients with bladder augmentation may not be candidates for this procedure unless they can still achieve appropriate bladder pressures through reflex contractions. Patients should be thoroughly evaluated and counseled regarding the effect of any prior procedures or conditions.

Post-operative incontinence may occur following posterior rhizotomy, which is typically performed in conjunction with implantation of the *VOCARE Bladder System*. While rhizotomy generally abolishes reflex incontinence, some patients may still experience stress incontinence. Patients should be evaluated for open bladder neck pre-operatively and counseled regarding the factors that may increase the risk of stress incontinence.

Bowel motility may be affected by the rhizotomy procedure and by use of the *VOCARE Bladder System*. Patients should be advised that the rhizotomy may decrease the response to suppositories and digital stimulation of the rectum. Conversely, use of the *VOCARE Bladder System* for bladder management may affect bowel motility. Patients may need to adjust the frequency and/or method of their bowel management routine postoperatively.

The ***rhizotomy*** procedure typically performed in conjunction with implantation of the *VOCARE Bladder System* may cause loss of erectile function and ejaculation in men who had these responses before surgery.

Spinal instability may result from the laminectomies required during implantation and rhizotomy surgery. Patients should be evaluated carefully for added risk factors, such as significant osteoporosis or scoliosis.

Studies have not been conducted on the use of the NeuroControl *VOCARE Bladder System* in pregnant women.

Post-operatively, the patient should be advised to check the condition of his or her skin over the *VOCARE Bladder System* Receiver-Stimulator and leads daily for signs of redness, swelling, or breakdown. If skin breakdown becomes apparent, patients should contact their clinician immediately. The clinician should treat the infection aggressively, taking into consideration the extra risk presented by the presence of the implanted materials.

Unintended Stimulation: While there have been no reports of *VOCARE Bladder System* activation or malfunction due to electromagnetic interference (such as retail anti-theft detectors, airport metal detectors, or other electronic devices) testing has not been conducted to rule out the possibility of this occurring. Patients should be advised to notify their clinician if they experience **unintended** stimulation when the *VOCARE Bladder System* is **not** in use. If possible, patients should note when and where the stimulation occurred.

Keep it dry: The user should avoid getting the external components, cables, and attachments of the *VOCARE Bladder System* wet.

The patient and caregiver should be advised to ***inspect the external cables and connectors*** daily for fraying or damage and replace components when necessary.

To avoid possible interference, patients with electric wheelchairs should be advised to ***turn off their wheelchair controller*** prior to turning on the *VOCARE Bladder System* External Controller.

External Defibrillation: The effect of external defibrillation on the *VOCARE Bladder System* is unknown.

Patients should be advised to turn off the *VOCARE Bladder System* External Controller when not in use. ***The External Transmitter can become hot*** if the *VOCARE Bladder System* is left on for extended periods of time.

ADVERSE EVENTS

Devices similar to the *VOCARE Bladder System* have been implanted in patients in Europe, Australia, Asia and the US. Published reports (Brindley 1994a) describe relevant adverse events including implant infection (1%), exposure of the implanted components via dehiscence or ulceration (1%), and component failures (Brindley 1994b). These complications have occurred in relatively small numbers of patients. No failures of extradural electrodes have been reported to date.

About 30% of patients (Brindley 1990) have noticed an increase in sweating over the lower part of the body and/or undesirable changes in the pattern of their lower limb reflexes. These changes have never been permanent and have returned to preimplant status within three months to a year.

A clinical study in the US involved 23 devices (using extradural electrodes) implanted in 23 patients and 13 cumulative implant years (median implant duration = 1.2 years, range approximately 1 month to 2 years). Key adverse events (AEs) reported from this clinical trial include temporary anterior nerve root damage which resolved within 3 months (two cases), incomplete rhizotomy (one case), pathological fracture of L2 vertebra with resulting nerve compression (one case), and post-operative stress incontinence not present preoperatively (two cases).

Possible adverse events include:

- Device malfunction or electrode/lead breakage
- Spinal nerve root damage
- Infection
- Incomplete rhizotomy
- Skin breakdown
- Post-operative incontinence

CLINICAL STUDIES

Devices similar to the *VOCARE Bladder System* have been implanted in patients in Europe, Australia, Asia and the US. Published reports indicate that approximately 90% of patients with this implant use it for voiding and the majority have significant decrease in infection rate and improvement in continence (Brindley et al. 1986, 1990a).

A US clinical trial has been conducted, with results available from 23 complete spinal cord injured individuals implanted at 6 centers. The purpose of the trial was to prospectively demonstrate that the NeuroControl *VOCARE Bladder System* enables patients to urinate on demand with low residual volumes of urine. The study also evaluated other quality of life measures affected by the *VOCARE Bladder System.*

Design and Patients: A multi-center trial was conducted at 6 US sites using a common protocol. Patients were implanted with the VOCARE Bladder System combined with posterior rhizotomy. Patients were evaluated in the clinic to determine if the *VOCARE Bladder System* enabled them to urinate on demand with reduced residual volumes of urine. Patients also kept diaries to record voided volumes, incontinence episodes, and methods of bladder management. Patients served as their own controls, with comparisons made between post-operative and pre-operative function as well as between function with the *VOCARE Bladder System* ON and OFF post-operatively. Data were gathered pre-operatively, and at 3, 6, and 12 months post-operatively.

Of the 23 patients implanted with the VOCARE Bladder System, all were at least one year post-injury at the time of enrollment. All had histories of bladder complications, usually UTI's, autonomic dysreflexia, and reflex incontinence. Seventy percent were male, median age 40 years (range 14-67). All patients had clinically complete spinal cord injuries with 26% quadriplegic and 74% paraplegic patients.

Methods: Evaluations were conducted at baseline pre-operatively (23 patients), post-operatively at 3 months (23 patients), at 6-months post-op (21 patients) and at 12-months post-op (9 patients). Key measures included demonstration of voiding on demand with measurement of resulting residual volumes of urine. Secondary measures included evaluating the effect of the *VOCARE Bladder System* on incontinence, use of urinary catheters, use of medications, and urinary tract infections.

Table 1. Primary Effectiveness Measures (n=#)

	Pre-Op (n=23)	3 Month (n=21)	6 Month (n=20)	12 Month (n=12)
Patients who can micturate on demand >200 ml (100% of attempts)				
VOCARE Bladder System ON	NA	19/21 (90%)	18/20 (90%)	11/12 (92%)
VOCARE Bladder System OFF	4/23 (17%)	0/21 (0%)	1/20 (5%)	1/12 (8%)
Patients w/PVR < 50 ml				
VOCARE Bladder System ON	NA	17/21 (81%)	17/20 (85%)	9/12 (75%)
VOCARE Bladder System OFF	3/23 (13%)	1/21 (.5%)	0/20 (0%)	1/12 (8%)

Results: The NeuroControl *VOCARE Bladder System* enabled patients with complete spinal cord injury to urinate on demand with low post-void residual (PVR) volumes of urine.

Results of secondary endpoint studies indicate that patients eliminated the need for intermittent and indwelling catheters (68%), became more continent [(13/20)65%], reduced the need for anticholinergic medication [15/17 (88%)], eliminated episodes of autonomic dysreflexia [8/8 (100%)], and reduced the incidence of reported urinary tract infections (78%).

INDIVIDUALIZATION OF TREATMENT

For optimal outcome, the following elements should be considered when selecting candidates for the NeuroControl *VOCARE Bladder System*:

- Prior to implant, patients should show reflex bladder contraction with an increase in detrusor pressures over baseline of at least 35 cm H_2O in women and 50 cm H_2O in men during cystometry. This ensures that parasympathetic preganglionic neurons from the conus medullaris to the bladder are intact. Anticholinergic medication should be discontinued at least three days in advance of testing for most accurate results.

- A cystourethrogram should be performed to evaluate the bladder neck for risk of post-operative stress incontinence.

- Candidates for the *VOCARE Bladder System* should be in good health and be able to understand the operation of the *VOCARE Bladder System*.

- Spinal fixation hardware may interfere with the implantation and rhizotomy laminectomy sites. Hardware should be evaluated and its partial removal considered.

DIRECTIONS FOR USE

Specific Directions for Use can be found in the Clinician and User Manuals.

PATIENT COUNSELING INFORMATION

It is important that patients who are candidates for the NeuroControl *VOCARE Bladder System* be counseled regarding use and expectations for the device. The following should be considered in this counseling:

- Patients should be counseled regarding the reasons for and consequent advantages and disadvantages of the posterior rhizotomy procedure performed in conjunction with implantation of the *VOCARE Bladder System*, including loss of sacral sensation, decreased response to digital stimulation and suppositories, and (if present) loss of reflex erection and ejaculation in males.

- Patients with poor hand function or inability to transfer to a toilet seat should be counseled regarding their options and limitations for urine collection.

- Patients should be counseled on the importance of reporting problems which may compromise their health or the implant to their physician. Problems include skin breakdown, infections, changes in performance of the *VOCARE Bladder System* (function or sensation), etc.

- Patients should be counseled that there is a possibility of post-operative stress incontinence and should be advised regarding the risk factors for stress incontinence such as weight gain, postural changes, and weak or open bladder neck.

- The patient should be trained in the proper maintenance of the *VOCARE Bladder System*. A clinician should explain the operation and maintenance of the *VOCARE Bladder System* as described in the Clinician Manual and the Patient Manual.

- Patients should be trained in an alternative "back-up" method of bladder emptying in the event the *VOCARE Bladder System* is not producing adequate bladder emptying.

- Patients should be educated to recognize urine flow patterns or problems that might indicate improper function of the *VOCARE Bladder System*.

HOW SUPPLIED

The *VOCARE Bladder System* Implantable Receiver-Stimulator and the Extradural Electrodes are supplied in dual STERILE peel-pack packages. The Intradural and Extradural Probes and Test Cable are supplied in dual STERILE peel-pack packages. The Intraoperative Stimulator is provided non-sterile and is intended for use outside the sterile field. External Component Kits are provided for patients and replacement components can be obtained from NeuroControl Corporation.

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