Tibioperoneal Short Circuiting for Stump Neuroma Pain in Amputees: Revival of an Old Technique

M. Reza Boroumand, Dirk Schulz, Eberhard Uhl, Kartik G. Krishnan

BACKGROUND: **Stump neuroma pain in amputees can be quite challenging. Surgical treatment may be largely subdivided into neuromodulative and non-neuromodulative methods. The latter includes neurocapsis, insertion of nerve stump into the bone marrow, centro-central short circuit (CCSC), and coverage with vascularized soft tissue flaps. CCSC was shown to be extremely effective in alleviation of pain. Reports on CCSC for the treatment of stump neuroma pain have disappeared from the literature, with a shift toward neuromodulation for the treatment of pain irrespective of etiology.**

METHODS: **We observed 8 lower limb amputees undergoing CCSC of the sciatic nerve during a follow-up of 12 years. All had the same stump neuroma pain rendering them unable to wear their prostheses. The sciatic nerve was explored at the midthigh area, much proximal to the amputation site, and a short circuit was established between the tibial and peroneal parts of the nerve. Assessment was by means of pain quantification as per the quadruple visual analogue scale, medication intake, and ability to use prostheses.**

RESULTS: **The median worst quadruple visual analogue scale before surgery was 8.0. After surgery it decreased to 2.5 ($P = 0.00094$). Medication intake was reduced from regular intake of a combination of opioids, nonsteroidal anti-inflammatory drugs, tricyclic antidepressants, and pregabalin in all patients to irregular intake of nonsteroidal anti-inflammatory drug alone in 3 of 8 patients. All patients were able to wear their limb prosthesis since surgery.**

CONCLUSIONS: **CCSC is a simple, effective, and long-lasting method to treat painful stump neuromas in amputees. It should be strongly considered in deserving cases before resorting to neuromodulative methods.**

INTRODUCTION

Approximately 80% of limb amputations in the Western hemisphere are caused by peripheral vascular pathology, followed by traumatic amputations (~18%) and amputations as sequelae of cancer and congenital anomalies (~2%) (14, 16, 23). Traumatic amputations might have a higher incidence in developing parts of the world and in countries of civil and military unrest (8, 19, 29). Relative peace in the Western hemisphere notwithstanding, there is still quite a number of surviving traumatic amputees of the post-World War II period that use prostheses (5).

Almost all amputees describe phantom limb sensation in varying degrees of severity (6, 14, 16). Such phenomena are important, especially when the amputation involves the proximal levels of the extremities. Depending on the severity of the symptoms, amputation pain can be classified as 1) phantom sensation, 2) phantom limb pain, and 3) stump neuroma pain (or residual limb pain). These 3 sensations can coexist in the same patient at varying times of a given day and can be of varying duration (16). All of the types of pain are described by 60%–80% of amputees during the first few weeks after the amputation (16). However, 5%–10% report continuing amputation pain, especially stump neuroma pain, even after this empirical time span for pain cessation. A minority of the patients are unable to fit into their

Key words
- Amputation
- Centro-central short circuit
- Neuromodulation
- Postamputation pain
- Residual limb pain
- Stump neuroma pain

Abbreviations and Acronyms
CCSC: Centro-central short circuit
NSAID: Nonsteroidal anti-inflammatory drug
qVAS: Quadruple visual analogue scale
SD: Standard deviation

Division of Reconstructive Neurosurgery, Department of Neurosurgery, Justus Liebig University, Giessen, Germany

To whom correspondence should be addressed: Kartik G. Krishnan, M.D., Ph.D. [E-mail: k_g_krishnan@hotmail.com]

Supplementary digital content available online.

Citation: World Neurosurg. (2015) 84, 3:681-687.
http://dx.doi.org/10.1016/j.wneu.2015.04.038

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

prosthesis owing to stump neuroma pain. In some instances, patients develop intractable stump neuroma pain—as a hindering late development—even years after the amputation and having effectively used the prosthesis (17, 19, 32).

The management of recalcitrant stump neuroma pain can be challenging to patients and their clinicians. Surgery is indicated and might prove favorable in patients with posttraumatic stump neuroma pain, especially when all conservative means have been exhausted (7, 13, 17, 21). Slooff (32) in 1977 and later Samii (30), in 1981, described centro-central short circuit (CCSC) of peripheral nerve stumps to prevent the onset of stump neuromas, thus reducing the incidence of stump neuroma pain. This procedure is termed improperly in publications as centro-central *anastomoses*. For proper definition, we will continue to use the term CCSC. Many studies have confirmed the effects of centro-central short circuiting in minimizing stump pain (1, 2, 11, 12, 21, 22, 30, 32). However, in recent years the CCSC method seems to have completely disappeared from the literature and one observes a shift in favor of neuromodulative and multimodular therapy in pain syndromes (15, 17, 20, 24, 25).

This article focusses on the subgroup of amputees with painful sciatic nerve stump neuromas, who underwent several nonsurgical and surgical treatment options, but still had recalcitrant pain and, thus, were unable to use their prosthesis.

METHODS

Patients

During a 12-year period from 2000 to 2012, 8 lower extremity amputees (6 above knee and 2 below knee amputations) were treated using the method described later. The patients had been amputated several years before their referral to our clinic for stump neuroma pain; all of them had been fitted with appropriate prostheses. Among the 8 patients, 5 were men and 3 were women; the mean age was 52.9 ± 13.4 years (mean ± standard deviation [SD]); the age range was 28–71 years. All patients had undergone several nonsurgical as well as surgical methods of treatment for their stump neuroma pain. The 2 major complaints were: 1) a distinctive painful area of the stump along the projection line of the sciatic nerve that ended in a tender lump and 2) inability to wear their prostheses.

Indication for CCSC

A diagnostic perineural block of the sciatic nerve stump using 5 mL of 0.5% Carbostesin (bupivacaine, AstraZaneca GmbH, Wedel, Germany) was performed and showed immediate relief of pain. A positive diagnostic infiltration was an indication for surgical exploration and CCSC. Surgery was offered to patients with a pain history of at least 6 months. Patients presenting with a pain history of less than 3 months were encouraged to extend their conservative treatment strategy using additional drugs or transcutaneous electrical nerve stimulation and were reviewed 3 months later. Therefore, we determined an indication for surgical exploration and CCSC only when other nonsurgical methods were exhausted. The patient with the earliest indication for CCSC was seen at least 6 months after the initial presentation (mean ± SD: 20 ± 13.1 months; range 6–48 months; median 12 months).

Surgical Technique

Surgery is performed under general anesthesia with the patient positioned prone. A tourniquet is applied to the proximal thigh, if possible. A zig-zag skin incision is placed to the dorsal midline of the middle third of the thigh. After opening the deep facia, blunt dissection is carried out between the muscle bellies of the biceps femoris and the semitendonosus-semimembranosus muscles. The sciatic nerve is easily identified. Five to 8 cm proximal to the painful stump neuroma, the sciatic nerve is transected and separated into its peroneal and tibial parts, which run parallel, without any intraneural plexus formation (thus the separation is quite easy). Now we have 2 parts of the sciatic nerve, the peroneal part being slightly thinner than the tibial part. The ends of the 2 nerve parts are joined using microsutures (8-0 Ethilon, Ethicon-Deutschland, Norderstedt, Germany) and augmented with fibrin glue (Tissucol Duo 0.5 mL, Baxter, Höchstadt an der Aich, Germany) (**Figure 1**). This is the CCSC of the sciatic nerve. The CCSC is buried in the muscle. The tourniquet, when applied, is removed and meticulous hemostasis achieved. No drains are placed. The muscle layer is sutured loosely with absorbable sutures (2-0 Vicryl, Ethicon-Deutschland). The fascia is not sutured. The surgical wound is closed in 2 layers, after infiltrating the skin with 0.5% Carbostesin (bupivacaine, AstraZaneca) for postoperative pain management. A circular elastic bandage with mild compression is applied to the operated stump. Patients are discouraged from wearing their prosthesis for 7–10 days after surgery to not impede wound healing. Physiotherapy and reuse of the prosthesis are started thereafter.

Assessment

The major presenting symptom was pain. The quality of pain was documented as electrifying, crushing, and provoked by compression (wearing the prosthesis) or palpation. Pain was quantified using the quadruple visual analogue scale (qVAS), which documents pain perception on a scale of 0 (no pain) to 10 (suicidal pain) at 4 time-points 1) level of pain as the examination was being conducted, 2) on average, 3) at its best, and 4) at its worst. The preoperative and postoperative values are shown in **Table 1** and **Figure 2**.

The list of pain medication was documented. Preoperative medication included nonsteroidal anti-inflammatory drugs (NSAIDs; all patients), opioids (5/8 patients), tricyclic antidepressants (3/8 patients), and pregabalin (5/8 patients).

The ability of the patients to wear their prostheses was documented. No patient was able to wear the prosthesis before CCSC and all patients were able to do so after the operation.

Statistical Analysis

Because the evaluated qVAS data were obtained from the same set of patients before and after surgical intervention, the Wilcoxon signed ranks test was used to calculate statistical significance using a level of 0.05 in a 2-tailed hypothesis. However, the sample size ($n = 8$) was not large enough for the distribution of the Wilcoxon W statistic to form a normal distribution. Therefore, it was not possible to calculate an accurate P value. Thus the P value was calculated separately from the z-score obtained through the Wilcoxon analysis.