

Informed Decision-Making Regarding Amputation for Complex Regional Pain Syndrome Type I

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Background: Literature on complex regional pain syndrome type I (CRPS-I) discussing the decision to amputate or not, the level of amputation, or the timing of the amputation is scarce. We evaluated informed decision-making regarding amputation for CRPS-I.

Methods: We describe our findings in a retrospective study of the decision-making process of thirty-six patients who underwent amputation for CRPS-I at our university medical center from 2000 to 2012. Additionally, we present the incidents preceding the CRPS-I, the reasons for and the levels of the amputation, and the outcomes after the amputations.

Results: Team members and the patient decided together whether or not to amputate and the level of amputation. Issues such as level of pain or allodynia, infection, desired length of the residual limb, joint range of motion, strength of all extremities, ability to use walking aids, and psychological “green, yellow, and red flags” were weighed in this process. There were no complications during the amputation surgery, a 22% rate of complications (infection in all but one patient) immediately postoperatively (reamputation not required), a 72% rate of phantom pain immediately after or within the first three months after the amputation, and a 77% rate of phantom pain more than one year after the amputation.

Conclusions: Informed decision-making regarding amputation for CRPS-I remains a complex process for which little evidence is available to support patient choices; patient-specific outcomes are not predictable. However, amputation should not be ignored as a treatment option for long-standing therapy-resistant CRPS-I.

Level of Evidence: Therapeutic Level IV. See Instructions for Authors for a complete description of levels of evidence.

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Complex regional pain syndrome type I (CRPS-I) is a disabling condition that can develop after an injury, after a surgical procedure, or spontaneously and is characterized by severe pain in combination with sensory, autonomic, motor, and dystrophic symptoms^{1,2}. The etiology of CRPS-I has not been clarified^{1,2}. The incidence of CRPS-I is estimated to be 26.2 per 100,000 person-years (95% confidence interval [CI], 23.0 to 29.7)³, with the majority of cases developing after fracture, sprain, or surgery. CRPS-I should not be confused with CRPS-II, which develops after a nerve injury and requires different treatment.

Patients are treated in accordance with guidelines, which primarily focus on pharmacotherapy and physical therapy^{4,5}. About 16% (95% CI, 9% to 22%) of patients in a CRPS-I outcome study reported the syndrome to be severely progressive despite interventions⁶. In a minority of cases, treatment does not reduce or resolve pain and the affected limb may become nonfunctional, preventing participation in activities of daily living and work⁶. As a last resort, some of these patients request amputation.

Guidelines support amputation as a treatment only in the presence of therapy-resistant wounds or infection. In general,

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TABLE I Green, Yellow, and Red Flags in Psychological Assessment of Patients Requesting an Amputation of a CRPS-I-Affected Limb

Green Flags*	Yellow Flags†	Red Flags‡
Patient initiative request for amputation	Mood or anxiety problems	Mood disorder
Internal locus of control	External locus of control	Anxiety disorder
Adequate social support	Low resilience	Automutilation
Having a relationship	Lawsuit regarding onset of syndrome	Somatization
Behavior intended for health promotion	Passive coping	Personality disorder
Expectation of functional improvement	Perfectionism	Substance disorder
Good learning capacity	Worrying/catastrophizing	
Regular sports activity		
Volunteering or having a job		

*Green flags indicate a tendency toward positive advice regarding amputation. †Yellow flags indicate issues that need to be addressed during the decision-making process. ‡Red flags indicate a tendency toward negative advice regarding amputation.

guidelines warn against amputation because of the high recurrence rate of CRPS-I and poor usage of prostheses among this patient group. Wide variation in recurrence rates has been reported⁷. The highest recurrence rate was 100% in a study of twenty-eight patients⁸. The lowest recurrence rate, 24%, was reported recently⁹.

Amputation of the affected limb of patients with long-standing therapy-resistant CRPS-I is an uncommon and much debated treatment option^{5,7,10}. Reports on amputation for CRPS-I have been lacking with regard to their discussion of decisions regarding amputation, such as its level and timing⁷.

To help others prepare for an informed decision-making process when amputation for CRPS-I is being considered, we describe the clinical procedures before amputation at our center. We present an analysis of the causes of CRPS-I, the reasons for amputation, the levels of amputation, and the short-term outcomes of amputation in a group of thirty-six patients at our university medical center who underwent amputation for CRPS-I from 2000 to 2012.

Materials and Methods

From May 2000 to September 2012, thirty-six patients (four male and thirty-two female) with long-standing therapy-resistant CRPS-I underwent an amputation at the University Medical Center Groningen, the Netherlands. CRPS-I was diagnosed with use of the International Association for the Study of Pain (IASP) and Bruehl criteria^{1,2}. All patients had unbearable and therapy-resistant pain in a nonfunctional limb that negatively affected participation in daily life. All patients had repeatedly expressed a wish for amputation of the affected limb.

Following the decision to undergo amputation, patients participated in an observational study on CRPS-I. A retrospective review of these patients' medical records was performed. Medical Research Ethics Committee approval for this study was not required. Approval of a concurrent quality-of-life study was granted (METc 2009/117). Results from that study have been published⁹.

Data from medical records concerning the incident preceding the CRPS-I and the duration of the CRPS-I, treatments before amputation, reason for amputation, level of amputation, complications during or after amputation, and the presence of phantom pain and symptoms of CRPS-I after amputation were collected. Data on the use of prostheses, recurrence of CRPS-I, and presence of phantom pain at three months after amputation were also retrieved

from the medical records. Data regarding recurrence of the syndrome more than one year after amputation were retrieved from the amended quality-of-life database (n = 26), as was information on phantom sensations, phantom pain, and residual limb pain at more than one year (n = 35)⁹. Data analysis was performed with IBM SPSS Statistics 20 for Windows (Armonk, New York).

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Clinical Procedures Before Amputation

All patients were screened by a physiatrist, a psychologist or psychiatrist, a physical therapist, and a vascular surgeon before any decision to undergo an amputation was made.

The physiatrist diagnosed the syndrome as CRPS-I according to IASP and Bruehl criteria^{1,2}. Alternate diagnoses such as (missed) fractures, nerve entrapment, CRPS-II, and post-stroke shoulder-hand syndrome were considered, and additional tests (ranging from radiographs and blood-flow echo Doppler studies to bone scans) were performed if needed. Diagnoses other than CRPS-I were excluded before amputation and, if present, were treated appropriately. Joint contractures and muscle strength were assessed, and after-amputation goals were discussed with the patient. Together with the vascular surgeon, the physiatrist and the patient discussed the potential level of amputation. The choice was based on the level at which the patient experienced no pain or allodynia, the presence and extent of infection and necrosis, and the desired length of the residual limb as influenced by the patient's motivation for rehabilitation (to achieve postoperative functioning of the limb) and motivation for use of a prosthesis. Comorbidity and obesity were considered according to standard amputation and rehabilitation procedures¹¹.

The physical therapist measured joint motion and muscle strength of all extremities, tested the ability to use walking aids by patients with an affected lower limb, and discussed after-amputation goals and presumed benefits with the patient.

The psychologist or psychiatrist assessed the patients for major psychopathology and regarding their ideas about beneficial and adverse effects of amputation. A semistructured interview, developed since amputations began to be performed for this syndrome in our hospital, and several questionnaires (Hospital Anxiety and Depression Scale, Connor-Davidson Resilience Scale, Symptom Checklist-90, and World Health Organization Quality of Life-BREF) were used to support the interview. The psychologist used "green, yellow, and red flags" to indicate a tendency toward more positive or more negative advice regarding whether a patient should have an amputation (Table I).

The health-care professionals then discussed the findings of the physical and psychological examinations with the patient. All possible effects of

TABLE II Occurrence of Phantom Sensations, Phantom Pain, and Residual-Limb Pain, as Well as Impediment Due to These Conditions in Thirty-five Patients with Amputation Because of CRPS-I

	No. (%) of Patients		
	Phantom Sensations	Phantom Pain	Residual-Limb Pain
Frequency			
Never	5 (14)	8 (23)	10 (29)
Several times a year	6 (17)	4 (11)	3 (9)
Several times a month	1 (3)	5 (14)	4 (11)
Several times a week	2 (6)	4 (11)	3 (9)
Several times a day	5 (14)	7 (20)	5 (14)
Several times per hour	2 (6)	1 (3)	3 (9)
Continuously	14 (40)	6 (17)	7 (20)
Impediment*			
None	9 (26)	1 (3)	1 (3)
Hardly any	8 (23)	10 (29)	5 (14)
Moderate	6 (17)	7 (20)	9 (26)
Much	5 (14)	5 (14)	5 (14)
Very much	2 (6)	4 (11)	5 (14)

*Impediment for patients who experience the condition. Due to rounding off percentages may not add up to 100%.

amputation (positive and negative) were discussed. Patients' expectations were further explored. Patients were asked to formulate Specific Measurable Attainable Realistic Time-bound (SMART) goals. Positive and negative effects of amputation for CRPS-I were derived from all known case studies and provided guidance for discussions with patients⁷.

Obese patients were strongly advised to lose weight prior to the amputation. Patients with muscle weakness of limbs not affected by CRPS-I were referred to a physical therapist for muscle training prior to a possible amputation. When a patient had joint contractures of limbs not affected by CRPS-I, an attempt was made to improve range of motion through stretching and exercises. Failed therapies were discussed, and treatment options that had not yet been tried but are advised in guidelines were offered to the patient^{5,10}.

Results

An amputation was performed on six upper limbs (two transradial and four transhumeral) and thirty lower limbs (twelve transtibial, thirteen knee disarticulation, and five transfemoral) after a median duration of CRPS-I of 4.5 years (interquartile range [IQR], two to eight years). Patients had a median age of thirty-nine years (IQR, twenty-seven to forty-five years). CRPS-I occurred after a sprain in sixteen patients, after surgery or arthroscopy in eleven patients, after obvious overuse in three patients, after a skin burn in one patient, and after a needle-stick injury in the hand in one patient. CRPS-I always occurred on the side of the inciting event. CRPS-I occurred spontaneously in four patients. All patients had been treated in other hospitals and came to our medical center on their own initiative with the desire for amputation. All patients reported unbearable, therapy-resistant pain in a dysfunctional limb as the reason for their request for amputation. Thirty patients had joint contractures affecting mobility and use of the limb. Eleven patients had a nonhealing wound or infection, and in two patients this contributed to the decision to amputate because of a fear of sepsis.

Before they requested amputation at our center, all patients had been treated elsewhere with a wide variety of therapies, including physical therapy, occupational therapy, and pharmacotherapy⁹. Six patients had a surgical sympathectomy without satisfactory resolution of the pain. Time-contingent physical therapy, either abroad or in the Netherlands, had been provided for twelve patients, without satisfactory results.

In one patient, muscle weakness of the lower limb not affected by CRPS-I was found by the physical therapist and the amputation was postponed. After a sufficient increase in muscle strength, the amputation was performed.

From 2006 onward, our center used a digital patient information system. Therefore, we were able to trace medical records from patients who were referred to our center with a request for amputation due to CRPS-I from September 2006. Amputation was recommended to one additional patient, who returned to his referring center for amputation. Seven patients were denied amputation by the physiatrist. CRPS-I could not be diagnosed in four patients. Two patients were advised to undergo additional physical therapy. One patient expected her generalized dystonia to disappear after amputation, which was not expected by the team, who thus denied the request for the amputation.

No complications during surgery were documented in the medical record. Eight patients (22%) developed a complication postoperatively, and two of them had had a therapy-resistant wound prior to amputation. Infection developed in the residual limb in five patients: during the hospital stay in three of them and after the hospital stay in two, who then had to be readmitted due to the infection of the residual limb. Treatment consisted of irrigation and debridement and antibiotics. Another amputation was not required. One patient developed ischemia in the distal part of the hamstrings, which was surgically debrided.

Superficial skin infection at the epidural needle insertion site occurred in two patients, in whom it was successfully treated.

Twenty-six patients (72%) experienced phantom pain directly after the amputation or developed phantom pain within the first three months after the amputation. More than one year after the amputation, thirty (86%) of the thirty-five patients experienced phantom sensations, twenty-seven (77%) experienced phantom pain, and twenty-five (71%) experienced residual-limb pain with a wide range of frequency and disability (Table II).

The CRPS-I did not recur immediately after or within three months after the amputation in any patient. The quality-of-life database indicated that CRPS-I (diagnosed according to the Bruehl criteria) recurred in seven (27%) of twenty-six patients more than one year after amputation. The CRPS-I recurred in the residual limb in four of these patients, in another limb in one, and in both the residual limb and another limb in one. One patient underwent an amputation of another limb due to CRPS-I in another hospital in the time frame between the first amputation and our study. (Although we could not formally document recurrence of CRPS-I in that patient, we considered it as a recurrence.)

Twenty-nine patients (81%) had the amputation above the allodynia level; four, through the level of allodynia; and three, distal to this level. One patient with recurrence in the residual limb had amputation distal to the allodynia level. Analysis of data from the quality-of-life database showed that recurrence in the residual limb or in another limb was not related to the level of amputation based on the level of allodynia (Fisher exact test, $p = 0.691$ for recurrence in the residual limb and $p = 0.646$ for recurrence in another limb).

Only one of the six patients with an amputation of the upper limb used a prosthesis. Of the thirty patients with a lower-limb amputation, twenty-two (73%) were fitted for a prosthesis and twenty-one used it (Fisher exact test, $p = 0.029$). No difference in sex or age were found between prosthesis users and nonusers.

Discussion

This report describes the process of informed decision-making in a group of patients before they underwent amputation due to CRPS-I and the short-term outcomes after the amputations. Informed decision-making concerns the issues of whether or not to amputate and the level of amputation but also involves formulating SMART goals with the patient and treating specialists. All team members (physiatrist, vascular surgeon, physical therapist, and psychologist or psychiatrist) and the patient make this decision together. Factors influencing the decision are the level of pain, presence of infection, desired length of the residual limb, motivation for use of a prosthesis, comorbidity, obesity, joint motion, strength of all extremities, ability to use walking aids, and psychological “green, yellow, and red flags.” The decision-making process for amputation due to CRPS-I is very different from that for amputation due to cancer, infection, or vascular disease. In the latter cases, amputation may be a lifesaving option and the only obvious “choice,” whereas surgeons may have difficulty in deciding to remove a

viable limb with CRPS-I. It should be kept in mind, however, that life with excruciating pain and a dysfunctional limb may be even more disabling.

Amputation is an uncommon and debatable treatment for CRPS-I^{4,7,10}. Amputation as a last-resort treatment has led to positive as well as negative outcomes^{7,9,12}. Some important findings from the current study may help to inform patients who request an amputation because of CRPS-I and their treating physicians. Twenty-six patients (72%) experienced phantom pain immediately after or within the first three months after amputation, and phantom pain remained present in 77% of patients more than one year after amputation. However, disability due to the phantom pain varied (Table II). The syndrome recurred in the residual limb or another limb in 27% of the patients, but it was not related to the level of amputation based on the level of allodynia.

It is important to point out that both the patient and the clinician may feel frustrated after many years of failed treatments and that an amputation of an affected limb may offer new perspectives but also the risk of new problems. A majority of patients in our study came to our outpatient clinic on their own initiative with the (repeated) wish for amputation. Patients who underwent amputation in this cohort were capable of formulating SMART goals, and psychological assessment revealed predominantly green flags. This report does not address the question of how patients came to the decision to request amputation initially. Rather, we considered the process of how health-care professionals arrived at a final decision together with the patient. Within the informed-decision-making process of patients and health-care professionals, one of the issues addressed is creating realistic expectations. Patients with other conditions, such as a mangled foot after trauma, poliomyelitis, or a Charcot foot, may also request an amputation. A retrospective cohort study of eighteen patients with a below-the-knee amputation because of intractable foot and ankle pain¹³ showed outcomes similar to those in our patient group⁹: a decrease in overall disability, an increase in participation in sports and employment, and a decrease in impediments due to pain. In a qualitative study of six patients who underwent an elective amputation, ongoing pain was the key reason for the wish for an amputation¹⁴. A lack of limb function, including problems with walking and wearing normal footwear, and a desire to improve participation in daily life activities and sports appear to be the second and third most influential factors for patients deciding to have an elective amputation¹⁴. Patients stress that the decision to undergo an amputation should be based on their personal wish¹⁴. Patients who underwent a CRPS-I-related amputation had greater satisfaction with the result when they themselves had initiated the request for the amputation⁸. Patients' satisfaction with the result after amputation was related to how closely the result fit with their pre-amputation expectations¹⁴. Therefore, close attention should be paid to the R(ealistic) SMART goal. Meeting with a peer who has undergone an amputation may also provide the patient with information¹⁴.

One of the major concerns about amputation for CRPS-I is the fear of recurrence of the syndrome. A high rate of

recurrence of CRPS-I symptoms after amputation has been reported^{8,15}, and guidelines have warned against amputation as a treatment option¹⁰. The latest guideline for CRPS-I mentions amputation only in a minor remark⁴. However, in our center, the recurrence rate is much lower than those in other studies, with good outcomes reported in terms of quality of life, frequent prosthetic use, and patient satisfaction⁹. It has been assumed that CRPS-I symptoms in the residual limb are more likely to recur when amputation is performed at a level in which CRPS-I symptoms are still present⁸. We could not find evidence for this assumption. Although our findings do not support the performance of amputation above the level of allodynia to prevent recurrence, we do agree with the suggestion to amputate above the level of allodynia until more evidence is found regarding this phenomenon⁸. A comparison of the residual limbs of patients with CRPS-I diagnosed according to the Bruehl criteria (including pinprick and light touch) and those of patients with other causes of amputation may provide information on normal patterns of residual-limb pain, sensibility, edema, and trophic changes.

Although an active stress-loading program as a treatment for CRPS-I was described in 1987¹⁶, it was not until around 2003 that it became known that a similar approach was being used in Macedonia. This treatment was implemented in the Netherlands thereafter¹⁷. Pain-exposure physical therapy (PEPT) for long-standing CRPS-I now offers promising results; some improvement in function was achieved in ninety-five of 106 patients with long-standing CRPS-I¹⁷. PEPT is not yet advised in guidelines. In our cohort, twelve patients (one in three) received PEPT but none reported benefit from it. We do not know how many patients may have avoided amputation by following PEPT.

Others (roughly) estimated that nearly all amputations can be avoided by using PEPT¹⁸.

Due to the contradictions reported about CRPS-I treatment, guidelines advise against performing amputations for this condition. The aim of our research was to assist clinicians with the difficult task of providing evidence-based advice to patients who request amputation for CRPS-I. Specifically, we have provided insight about a cohort of patients who were treated with amputation at our center and the accompanying decision-making process utilized. Informed decision-making regarding amputation for CRPS-I is a team process involving health-care professionals as well as the patient. Amputation as a possible treatment option for long-standing therapy-resistant CRPS-I may be considered after other evidence-based options have failed. ■

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