PLASTIC RECONSTRUCTIVE & REGENERATIVE SURGERY

2025:34-43
DOI: 10.57604/PRRS-1394

THE ROLE OF THE PLASTIC SURGEON IN SUSPECTED SPIDER BITES: CASE SERIES AND ITALIAN NATIONAL SURVEY ON DIAGNOSIS AND TREATMENT

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Summary

Introduction. Spider bite injuries are an emerging topic of interest worldwide. Although the incidence of cases appears to be rising, European literature provides only limited insight. This study aims to characterize suspected spider bites in Italy, highlight the role of the plastic surgeon in treatment, and lay the groundwork for future research. Medically significant spiders in Italy include Loxosceles rufescens, Latrodectus tredecimguttatus, and Cheiracanthium punctorium. Differential diagnosis, both in identifying the spider and in interpreting the clinical presentation of unverified cases, is complex.

Methods. A 10-question survey was developed to investigate the epidemiological, diagnostic, and therapeutic aspects of spider bites and was distributed to members of the Italian Society of Plastic, Reconstructive, and Aesthetic Surgery. Additionally, a case series of four moderate-to-severe suspected spider bite injuries is described.

Results. The survey, involving 40 plastic surgeons, revealed that cases are rare and spider identification is often uncertain. Within a year, 47.5% of respondents reported no systemic symptom cases, and 45% treated only one patient. Antibiotics were the most commonly used medications, and biopsy was deemed the most useful diagnostic tool. Enzymatic or autolytic debridement was performed in 66.7% of cases, while immediate reconstruction was rare. The case series included one secondary-intention healing, one skin graft reconstruction, and two free flap reconstructions.

Conclusions. Three patients in the case series experienced further necrosis development within 5 weeks of onset. Delayed reconstruction after 5 weeks appears to be advisable. Establishing a national database in collaboration with arachnologists could enhance future studies and guidelines development.

Key words: spider bite, loxosceles, violin spider, treatment, reconstruction

Received: June 4, 2025
Accepted: July 14, 2025
Published online: July 28, 2025

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How to cite this article: Pandolfo G, Isaia M, Germano S, et al. The role of the plastic surgeon in suspected spider bites: case series and italian national survey on diagnosis and treatment. PRRS 2025;4:34-43. https://doi.org/10.57604/PRRS-1394

INTRODUCTION

Compared to other continents, Europe hosts very few species of spiders of medical importance, most of them being distributed in the Mediterranean Basin. Italy stands among other European countries for the remarkable richness of the spider fauna, currently accounting for 1,734 species [1]. These also include representatives of genera such as Latrodectus and Loxosceles that are responsible for clinical syndromes of medical interest, namely latrodectism and loxoscelism [2].

The lack of clear diagnostic symptoms of a spider bite and the need of a specific expertise for the correct species identification, lead to a significant overdiagnosis of spider bites and envenomation in the medical literature [3]. Moreover, a recent major role in spreading falsehoods about spiders has been associated with excessive sensationalism used in traditional and social media [4,5].

In addition, ongoing climate and habitat change are predicted to have a positive effect on the frequency of human-spider encounters [6] and to increase the progressive establishment of new alien species from other continents – including species of medical importance – many of which have a high potential to establish in urban areas.

Currently there is no standardized treatment protocol for suspected spider bite lesions. The plastic surgeon may be involved in the treatment of suspected spider bite lesions, since skin necrosis is one of the most frequent clinical manifestations [7].

The aim of the article is to characterize the phenomenon of suspected spider bites in Italy through a national survey involving 40 Italian plastic surgeons and a case series of four patients treated in a single Plastic Surgery Unit.

Spiders of medical interest in Italy

Spiders are essentially generalist predators that feed on other arthropods. Not being potential prey, human biting is an accidental event that occurs when the spider is inadvertently touched or crushed. In most cases, the consequences of the bite resolve relatively quickly without outcomes, however the bite of the species hereinafter may have consequences of medical relevance [8,9].

Loxosceles rufescens (Dufour, 1820) is a yellowish-brown spider with long legs and an average body length of approximately 7-8 mm bearing six eyes arranged in pairs. The species is originally native from the Mediterranean area but due to human activity the species has spread globally. In nature it is preferably found under stones, in crevices and caves. The species has a high affinity for human buildings [1,10,11].

Bite features: initially painless without local alterations; in the following hours, a reddish blister lesion begins to appear with itching, burning and paresthesias. Within the next 48-72 hours, it may necrotize and ulcerate. In addition to the injection of venom, anaerobic bacteria can infect the wound and can complicate the course of the lesion with possible progressive necrotizing fasciitis [12].In severe cases, systemic symptoms may occur [13].

Cheiracanthium punctorium (Villers, 1789) is a species with Palearctic distribution, generally found among low vegetation in open and sunny environments, hidden in a silky sack-shaped burrow; rarely found in homes. The body length can reach 8-15 mm in length. The cephalothorax is brown while the abdomen is greenish-yellow with a dark spot lanceolate dorsally.

Bite features: very painful and followed by a mildly pruritic, erythematous area surrounded by paresthesias within 30 minutes. The bite may also be associated with a mild systemic syndrome but usually it does not cause necrosis [1,10,14,15].

Latrodectus tredecimguttatus (Rossi, 1790) is found throughout the Mediterranean Basin extending to central Asia to China. It has characteristic red dots on the black back even if the pattern may be highly variable, including specimen entirely black. The female has a body length of 7-15 mm long while the male is much smaller (4-7 mm). It does not usually nest inside homes but in low vegetation in arid environments and ruderal areas.

Bite features: very often unnoticed; a small red patch of 0.5 mm appears afterwards. After a few hours, the lesion grows up to 5 cm in diameter and gets painful and pale, surrounded by a bluish-red ring [1,2,16,17].

MATERIALS AND METHODS

A questionnaire (Tab. I) consisting of 10 questions was proposed to the Italian Society of Plastic, Reconstructive and Aesthetic Surgery ("Società Italiana di Chirurgia Plastica, Ricostruttiva-Rigenerativa ed Estetica – SICPRE") which approved it. After approval, the questionnaire was submitted by SICPRE to its members via e-mail with a link to answer an online survey on the official website "www.sicpre.it". The questionnaire has been designed to investigate the various epidemiological, diagnostic and therapeutic aspects related to spider bite lesions.

After the administration of the questionnaire, the authors received the report of the answers from the SICPRE webmaster. The data was processed using Microsoft Excel.

As regards case series, according with Sams' classification, one moderate and three severe cases with "probable" spider bite were considered for the selection of patients [18].

Table I. Questionnaire.

How many cases of spider bites did you treat in 2019?
0 — 1 — 2-4 — > 5
In how many cases has the spider been identified with certainty?
All — None — 1 — 2 — 3 — 4 — 5 — > 5 — > 10
In how many cases has the spider been identified with certainty?
Loxosceles rufescens — *Cheiracanthium punctorium* — *Latrodectus tredecimguttatus*
Number of cases with systemic involvement
Number of hospitalized patients
Number of cases undergoing surgical treatment
Medical treatment adopted
Antibiotics — Steroids — Painkillers — Antihistamines — Intensive Care
Second level exam that you consider essential — CT — MRI — Ultrasound — Ecodoppler — Biopsy
Most used local treatment:
Autolytic or enzymatic debridement – outpatient management - second intention healing
Urgent debridement in OR with ev. Fasciotomies – open treatment or NPWT and delayed cover with skin graft or flap
Urgent debridement in OR with ev. Fasciotomies - immediate cover with skin graft or flap

Spiders were not collected and thus not identified by experts, meeting only the first criterion of diagnosis of a spider bite: evidence of a bite, including clinical effects at the time or soon after the bite, discomfort or pain [19]. Patients have been treated at a single plastic surgery unit in the last 5 years and they all signed informed consent for the use of clinical data and photographs for scientific purposes. Patients with mild lesions without necrosis, patients with a history of previous skin ulcers were excluded from the case series.

RESULTS

After the administration of the questionnaire, the authors received from the SICPRE webmaster the report of the answers (Tab. II): there were 40 participants, questions n° 2, 8 and 10 recorded 39 answers, question n° 9 received 38 answers.

Cases handled in one year

Among the 40 responses, 20 Operative Units they treated only one case in one year, in 16 they treated 2-4 cases, in 4 they treated more than 5 cases.

Spider identification

A total of 39 responses were given. The spider was neither collected nor identified with the help of an expert in any of the 7 operating units (17.9%). In 15 responses (38.5%) it is stated that the spider has been identified in all cases despite no expert was ever consulted.

Spider species

Among the 40 responses, Latrodectus tredecimguttatus and Cheiracanthium punctorium were never identified. The spider was identified in 57.5% of cases and it was always Loxosceles rufescens. In 42.5% of cases the species was not identified.

Systemic symptoms and hospitalized cases

The data obtained from these two questions are exactly superimposable: the same number of answers in the various sections.

In effect, 47.5% of the participants (19) responded that no case experienced systemic symptoms and the same percentage stated that they had not admitted any patients. The equivalence is repeated in cases with 1, 2 or 3 affected patients, showing that cases with systemic symptoms are equivalent to hospitalized cases.

Cases undergoing surgery

As regards surgery, 22.5% say they have not operated on any cases, 45% operated on only one case, 12.5% operated on 3 or more cases.

Systemic therapy

Concerning systemic therapy, 84.6% administered antibiotics, 12.5% steroids. Only one participant said they used an antihistamine. No one selected painkillers as the only therapy. In no case did the patient require resuscitation.

Second level exams

The instrumental exams considered essential are, in order: Biopsy (21.1%), MRI (15.8%) and Ultrasound (15.8%) equally, CT Scan (13.2%) and Eco-Doppler (7.9%).

Table II. Results.

Answers: 40	How many cases of spider bites did you treat in 2019?	
1	20	50%
2-4	16	40%
> 5	4	10%
Answers: 39	In how many cases has the spider been identified with certainty?	
No one	7	17.9%
1	9	23.1%
2	3	7.7%
3	2	5.1%
4	1	2.6%
5	0	0%
> 5	2	5.1%
All	15	38.5%
Answers: 40	What species did the spider belong to?	
Unknown species	17	42.5%
Loxosceles rufescens	23	57.5%
Cheiracanthium punctorium	0	0%
Latrodectus tredecimguttatus	0	0%
Answers: 40	Number of cases with systemic involvement	
0	19	47.5%
1	17	42.5%
2	3	7.5%
3	1	2.5%
Answers: 40	Number of hospitalized patients	
0	19	47.5%
1	17	42,5%
2	3	7,5%
3	1	2,5%
Answers: 40	Number of cases undergoing surgical treatment	
0	9	22.5%
1	18	45%
2	8	20%
3	2	5%
4	1	2.5%
> 4	2	5,0%
Answers: 39	Medical treatment adopted	
Antibiotics	33	84.6%
Steroids	5	12.5%
Pain-killers	0	0%
Antihistamines	1	2.5%
Intensive care	0	0%
Answers: 38	Second level exam that you consider essential	
CT Scan	5	13.2%
MRI	6	15.8%
Ultrasound	6	15.8%
Ecodoppler	3	7.9%
Biopsy	8	21.1%
Answers: 39	Most used local treatment	
Autolytic or enzymatic debridement – outpatient management –second intention healing	26	66.7%
Urgent debridement in OR with ev. Fasciotomies - Open treatment or NPWT and delayed cover with skin graft or flap	12	30.8%
Urgent debridement in OR with ev. Fasciotomies - immediate cover with skin graft or flap	1	2.6%

Local treatment

As regards local treatment, 66.7% say they have treated patients in the outpatient office, through autolytic or enzymatic debridement to achieve healing by second intention. 33.4% of participants performed urgent surgical debridement in the operating room, of which: 30.8% with open treatment or negative pressure therapy followed by deferred graft/flap coverage; Only 2.6% (1 participant) reported immediate graft/flap coverage.

CASE SERIES

Case n°1 – Moderate

A 52-year-old woman came in the Emergency Department with dermonecrotic lesion of the thigh, with two small losses of substance interspersed with an intact skin bridge in an erythematous area (Fig. 1). No spider was noticed neither brought to the hospital. She was treated in the office with enzymatic debridement. After a week, a necrotic-colliquative subcutaneous collection developed and was drained and doxycycline 100 mg/die was prescribed for 7 days. She obtained secondary intention healing in 69 days. She did not show systemic symptoms.

Case n°2 - Severe

A 35-year-old woman came with necrosis of the radial side of the third finger of the dominant hand (Fig. 2A). Surgical debridement was initially performed in the outpatient clinic, followed by debridement in the operating room after 4 weeks due to extent of necrosis. Antibiotic therapy was started on infectious disease counseling for 3 weeks, after which further surgical debridement and free Proximal Ulnal Perforator flap (PUPF) coverage was performed [20].
The 6-months follow-up shows trophic flap with recovery of joint flexion-extension (Fig. 2B).

Case n°3 - Severe

A 46-year-old woman came in Emergency Department reporting development of ulcerated lesion of the leg with intense pain and fever. On clinical examination, a “red, white and blue sign” [21] is noted with progressive extension of necrosis by stages: first a central ulcer with erythematous peri-wound skin, then bluish spots developed and turned into dry necrosis (Fig. 3). Contrast-enhanced CT scan of the leg was performed and showed subcutaneous air bubbles but absence of necrotic-colliquative phenomena of the muscular fascia. The patient underwent surgical debridement in the operating room after 7 days. The surgical piece was sent for histological examination which demonstrated

Figure 1. Double lesion in erythematous area.

Figure 2. **A**) necrosis at first look; **B**) follow-up at 6 months.

a “dermo-epidermal inflammatory process with an abscessing appearance and with the presence of vascular thrombosis.” A biopsy was also performed for culture which showed the presence of Streptococcus agalactiae, Staphylococcus aureus and Corynebacterium striatum for which Amoxicillin/Clavulanic Acid was administered for 7 days.
Substance loss was managed with a two-stage approach: surgical debridement until the muscular fascia that appeared viable and bleeding and placement of Negative Pressure Wound Therapy (NPWT). Skin graft coverage was done after 20 days of NPWT. The skin graft was totally engrafted without complications (Fig. 4).

Case n°4 - Severe

A 59-year-old woman declared the development of ulcers at the volar surface of the radiocarpal joint,

Figure 3. **A**) red, white and blue sign; **B-C**) evolution of necrosis.

Figure 4. **A**) wound bed after 20 days of NPWT; **B**) skin graft without necrotic complications.

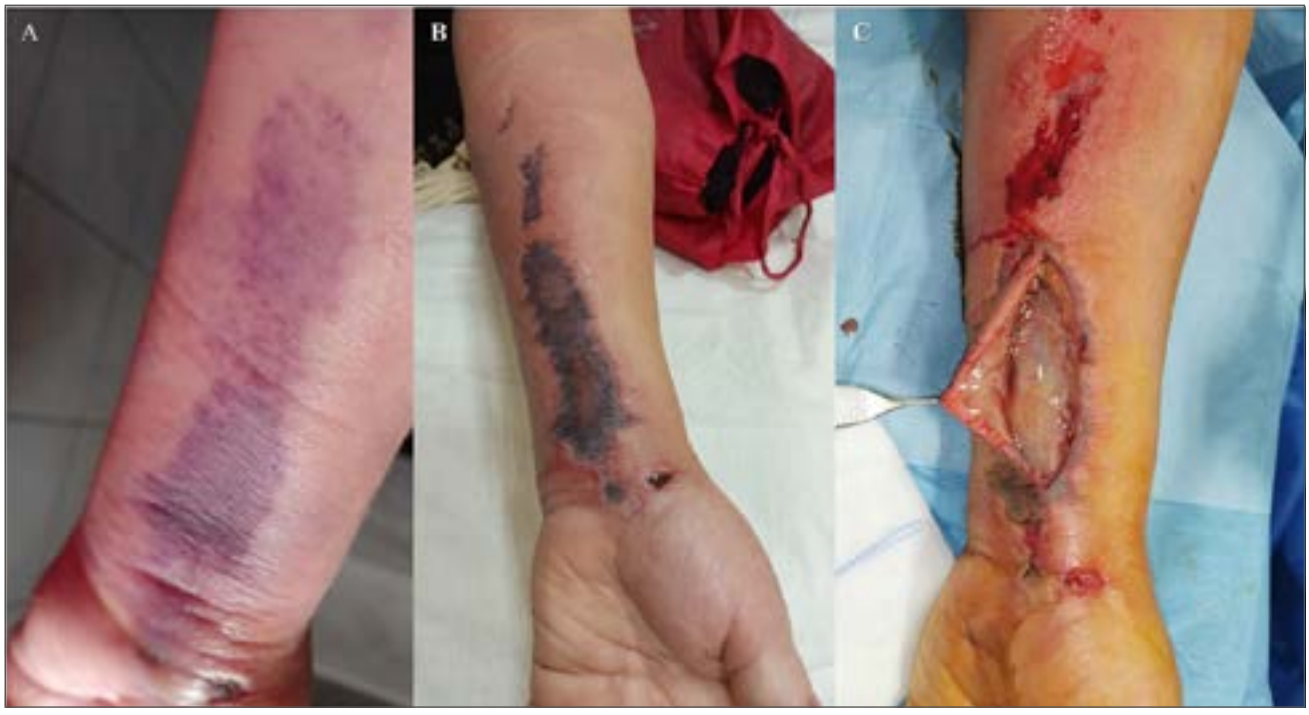

Figure 5. **A**) ulcer and red, white and blue sign; **B**) evolution of necrosis; **C**) antibrachial fascitis.

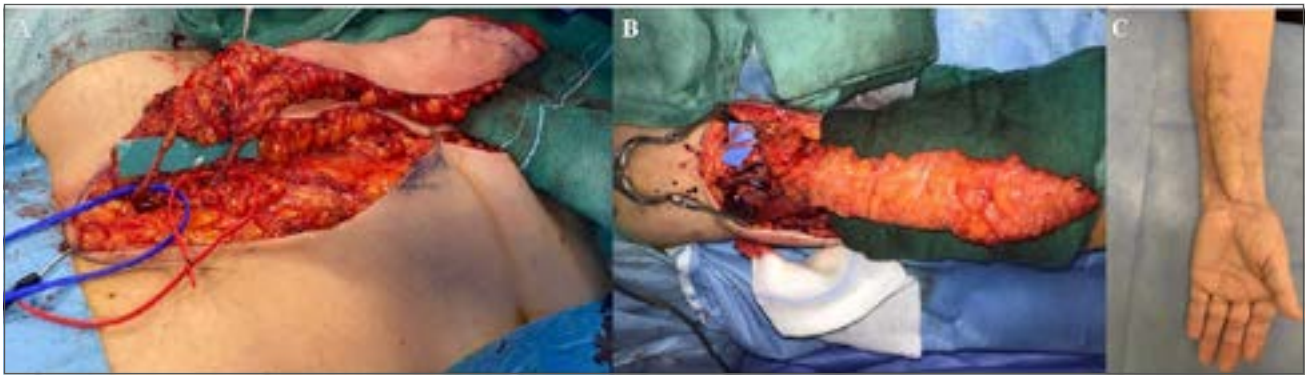

Figure 6. **A**) SCIP flap harvesting; **B**) insetting; **C**) one year follow-up.

initially painless; three days after the suspected bite, a painful bluish-red erythema developed on the forearm. She came to the hospital five days after the bite with necrotizing fasciitis of the antibrachial fascia (Fig. 5). She showed no systemic symptoms. An emergency fasciotomy and debridement of necrotic tissue was performed.

After 5 weeks of dressings, further surgical debridement and coverage of substance loss (10x4 cm) with Superficial Circumflex Iliac Perforator (SCIP) free flap was performed (Fig. 6A-B) [22].

On the third post-operative day, the flap showed moderate venous congestion associated with necrosis of the skin margins, for which further surgical debridement was performed and Hirudo medicinalis were applied for 4 days with resolution of venous congestion. After 30 days of medication and antibiotic treatment with Linezolid, on the recommendation of the infectious disease specialist, healing of the margins was achieved by secondary intention. Follow-up at 1 year shows trophic flap and no functional flexion-extension deficits are evident (Fig. 6C).

DISCUSSION

Spider bites in tropical and subtropical areas seem to be on the rise, representing a major medical problem: in Brazil in 2019 there are about 10,000 reports of bites of Loxosceles spp. per year [23]. There are no large-scale studies in the literature on the incidence of spider bites in Europe. The estimated annual frequency of non harmful spider bites in Switzerland is 10-100 bites per million inhabitants [6].

An european review on loxoscelism3 analyzing 38 publications, found that only 10% of cases were verified bites. Two published cases of alleged deathly bites (Thailand 2014, Italy 2016) referred to non-verified bites and were not considered reliable. All 11 cases of verified bites healed without complications within a few weeks. No fatal issues are known.

In a 10-years latrodectism study, bites of L. tredecimguttatus were characterized by generalized pain and abdominal rigidity and cramping, local pain and erythema at the bite sites [17].

The study, that includes a response rate of 40 participants, could be likely subject to selection bias (i.e., those more experienced with spider bites may have been more inclined to respond) with potential underestimation or overestimation of incidence.

The first question of our survey shows that in Italy 90% of plastic surgeons interviewed in a year have treated a maximum of 4 cases, with 50% declaring to have treated only one case. In none of the reported cases spiders were brought to the hospital and identified by expert arachnologists, so all of them should be regarded as suspected spider bites.

The main problem relating to studies on spider bites is linked to the lack of certain identification of the spider. Indeed, a verified case of spider bite should meet the following conditions [19]:

1 Evidence of a bite, including clinical effects at the time or soon after the bite [24]. Bites can be initially painless [25];
2 Collection of the spider at the time or immediately after the bite;
3 Identification of the spider by an expert arachnologist [26].

The uneven distribution of the number of cases with certain identification (second question: no cases 17.9%, all cases 38.5%), raises questions about the effectiveness of current diagnostic practices. In addition, the cases considered verified may be overestimated due to possible non-compliance with the identification criteria. In fact, although an italian study provides a recognition tool for clinicians to medically relevant italian spiders [10],

the differential diagnosis both in the identification of the spider and in the clinical picture in unverified cases remains complex.
The third question of the survey shows that while 42.5% did not identify the species of spider, 57.5% said they recognized Loxosceles rufescens.
There are a number of arthropods that could be mistakenly identified as spiders that can cause skin lesions with bites or stings [27]. Furthermore, the incorrect attribution of the clinical case to a spider bite, although it is a statistically rare event, could also be influenced by the persistence of arachnophobic sentiments in the society [4,5].
Skin lesions caused by Loxosceles rufescens are typically a single flat or slightly sunken focal lesion, occasionally double; pale, blue-white, or purple in the center with peripheral erythema, which tends to heal in 3 months [28].
In the first few days the "red, white, and blue sign" can be visible as a consequence of erythema, ischemia, and thrombosis [21].
This description corresponds to case n°1 (double lesion in erythematous area), case n°3 and n°4. Although the appearance of the skin may be suggestive of a Loxosceles bite, the differential diagnosis must take into consideration several more frequent conditions, such as infections or cancer [29].
It is known that in addition to skin lesions, the three spiders considered in this study can cause systemic symptoms. Loxosceles rufescens may be responsible for cutaneous loxoscelism (CL), where patients present a dermonecrotic lesion and nonspecific systemic symptoms, and the cutaneous-hemolytic or cutaneous-visceral form (CVL) [11-30].Latrodectus tredecimguttatus bite can cause latrodectism most characterized by generalized pain and abdominal rigidity [17].Cheiracantium punctorium bites may also be associated with fever, abdominal cramps, and vomiting [31].
In our study, 47.5% of plastic surgeons reported that they had no cases with systemic symptoms, 42.5% treated only one case with systemic symptoms, 7.5% treated two cases, 2.5% three cases. The exact same response rates with the relative numbers of cases are found in declaring hospitalized cases, suggesting that all cases with systemic involvement have been hospitalized.
An italian case report [32] documented a confirmed bite by Loxosceles rufescens with flu-like symptoms and cellulitis with lymphangitis.
As regards medical therapy, the majority of respondents treated patients with antibiotics. Although the inoculation of bacteria with spider bites is controversial, it is indicated to prevent secondary infections that can aggravate the clinical case [12-18].
Corticosteroids are indicated only in cases with systemic involvement [13] and risks and benefits should be weighed in case of signs of acute infection. Symptomatic treatment with antihistamine and RICE Therapy (rest, ice and elevation) [33]. In cases of loxoscelism, Phospholipase D (PLD), a molecule found in venom, can lead to massive inflammation and platelet aggregation [34], as possibly evident in the histopathological examination of case n°3; for this reason, the administration of acetylsalicylic acid could be considered [35]. Hyperbaric oxygen therapy appears to have a multifactorial therapeutic effect [37], while dapsone and specific antivenom where available are other therapies considered in several studies, with doubtful risk/benefit ratio [13-37].
The biopsy is the instrumental examination considered essential in most cases: indeed, the histopathological examination could be very useful in the differential diagnosis, while bacteriological examination could indicate the correct antibiotic where necessary. CT and MRI scan are indicated in severe cases with suspected involvement of the muscular fascia, while Ultrasound and Eco-doppler could be useful in cases with severe edema of a limb.
Local treatment can be addressed with immediate or deferred reconstruction.
In 66.7% of the reported cases, healing by second intention was pursued by autolytic or enzymatic debridement, suggesting that these were mild or moderate cases as shown in case n°1. In 30.8% of cases, urgent surgical debridement in the operating room was necessary and followed by deferred reconstruction with skin graft or flap after open treatment with or without NPWT. Cases with surgical debridement in the operating room (n°2, 3 and 4) were treated according to this procedure. Farace et al. [39] noted a necrotizing action even on engrafted skin grafts for about 5 weeks in suspected Loxosceles rufescens spider bitten victims. This finding is confirmed in our case series, where further necrosis developed within 5 weeks of onset in cases n°1, 2 and 4. The survey also shows the tendency of plastic surgeons to indicate deferred reconstruction, in fact only one participant (2.6%) declares to have performed an immediate reconstruction. Case n°3, treated with NPWT, despite being grafted 4 weeks after onset, showed no complications. Deferred reconstruction with PUPF free flap in case n°2 and with SCIP free flap in case n°4 guaranteed excellent preservation of flexion-extension function.

CONCLUSIONS

Diagnosis of spider bites is frequently hypothetical and many cases are not severe, do not require surgery with hospitalization and can be treated on an outpatient

basis. In cases deserving of surgery, it seems confirmed that waiting for the demarcation of necrosis and especially postponing reconstruction after 5 weeks from onset is a correct indication. In order to draw up guidelines, further studies are needed to analyze only confirmed cases that meet the three identification criteria, a problem that is also the main limitation of this study, which only illustrates suspected cases. Considering the difficulty in capturing or photographing the spider, in the already rare cases of spider bites, in order to have statistically significant large-scale studies, the solution could be to create a national site, as already done temporarily in the aforementioned Swiss study [6], in collaboration with expert arachnologists, to obtain databases of only verified cases for subsequent studies.

Conflict of interest statement
The authors declare no conflict of interest.

Funding
This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author contributions
GP, MB: A, D, W
MI: edited the arachnological part: W, DT
All authors affiliated with Maria Vittoria Hospital treated the patients: D, DT
All authors contributed to the design, corrections and final draft of the article: DT

Abbreviations
A: conceived and designed the analysis
D: collected the data
DT: contributed data or analysis tool
S: performed the analysis
W: wrote the paper

Ethical consideration
Not applicable.

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