

Collection of Practical Guides for Wounds of the Galician Health Service

A practical guide to acute traumatic soft tissue injuries. Guide No. 8



XUNTA DE GALICIA



XUNTA
DE GALICIA

CONSELLERÍA DE
SANIDADE

COLLECTION OF PRACTICAL GUIDES FOR WOUNDS OF THE GALICIAN HEALTH SERVICE

A PRACTICAL GUIDE TO ACUTE TRAUMATIC SOFT TISSUE INJURIES

Guide No. 8

Published by: Xunta de Galicia
Department of Health
Galician Health Service
Directorate General of Health Care

Design and layout: Versal Comunicación, S.L.

Year: 2021



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COLLECTION OF PRACTICAL GUIDES FOR WOUNDS OF THE GALICIAN HEALTH SERVICE

- N°1 Pressure Ulcers
- N°2 Ulcers of the Lower Limb
- N°3 Diabetic Foot
- N°4 Neoplastic Skin Lesions
- N°5 Burn Injuries
- N°6 Acute Surgical Wound
- N°7 Moisture Associated Skin Damages
- **N°8 ACUTE TRAUMATIC SOFT
TISSUE INJURIES**



PRESENTATION

Everyone knows that the approach to ulcers and wounds implies a health problem of great magnitude due to the loss of quality of life in patients, the impact that it has on their families and carers and also due to the workload that their care represents for healthcare professionals. To which must be added the additional cost that it poses for the economic sustainability of the healthcare system.

From the Galician Health Service (Sergas), we are aware of the importance and healthcare impact that the proper management of prevention and treatment of these types of lesions has; for this reason, the General Directorate of Healthcare has been working for years on this and more intensively to improve the structures, resources and conditions necessary to try to standardise and systematise the healthcare activity derived from this process of care.

The **Úlceras Fóra Programme**, was set up as a reference framework to develop and establish strategic lines in the approach to everything that is related to ulcers and wounds, and as one of the basic objectives includes the setting up of common care criteria (to identify the risk, assess the lesions, establish preventive measures, establish treatments, use of products, monitoring, registration, etc.) which allow us to move towards the unification of criteria and a corresponding reduction in the clinical variability for this type of lesions.

That is why this **Collection of practical guides for wounds from the Galician Health Service (SERGAS)**, describes the effort and enthusiasm of many professionals (doctors and nurses) to improve their clinical practice in the care and comprehensive approach to patients affected by ulcers and wounds, or at risk of suffering them, in order to incorporate the best available evidence available in order to achieve an improvement in the patient's quality of care and safety.

Jorge Aboal Viñas
Director General of Healthcare
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PREFACE

This practical guide was prepared with the participation of primary and hospital healthcare professionals from Sergas and reviewed by professional experts in the field and scientific institutions at national level, under the coordination of the Sergas General Sub-Directorate for Care Management and Innovation and General Directorate for Healthcare.

The evidence-based clinical practice recommendations included in this guide are of a general nature and therefore do not define a single course of conduct to be followed in a procedure or treatment for the integral care that is intended to be carried out. Any amendment or variation of the recommendations set forth herein, must be based on clinical judgement (internal evidence) of the healthcare professional who applies them and the best clinical practices of the time; as well as the specific needs and preferences of each patient in particular; the resources available at the time of the care and the regulations established by the institution or health centre where they are to be applied.

DISSEMINATION AND IMPLEMENTATION

The dissemination and implementation strategy of this practical guide; as well as, of the entire SERGAS Collection of practical guides for wounds, shall be coordinated through the Technical Management of the Úlceras Fóra Programme; that is to say, by the Healthcare Integration Department, of the Sergas General Sub-Directorate for Care Management and Innovation.

The dissemination process entails a protocol presentation at the Consellería de Sanidade of the Xunta de Galicia, the official presentation in all public institutions in the SERGAS healthcare network, the dissemination of an official statement to the media, its disclosure at scientific events and dissemination on the Internet through the official Sergas website.

VALIDITY AND UPDATING

The guide should be reviewed after 3 years from the date of its publication. Its may be updated before the end of this period if any of the evidence recommendations modify its categorisation, which may lead to a clinical safety risk to the patient and/or affect the quality of care.

DECLARATION OF CONFLICTS OF INTEREST AND EDITORIAL INDEPENDENCE

The authors of this practical guide declare to have made an effort to ensure that the information contained herein is complete and up to date, and state that they have not been influenced by conflicts of interest that could change the results or contents during the preparation and development stage of the guide. Furthermore, the authors of the guide assume responsibility for the content expressed, which includes evidence and recommendations.

The editors of the Galician Health Service's Collection of practical guides for wounds, declare that there is editorial independence regarding the decisions taken by the technical management and the coordinators of the working group.

ASSESSMENT AND CLASSIFICATION OF THE EVIDENCE

The scientific evidence and recommendations presented in this Practical Guide were the result of the assessment and analysis of the sources of information consulted as bibliographic reference (clinical practice guides, guidelines based on the best evidence, other documents based on evidence, systematic reviews and original articles); the critical reading method and consensus through a nominal group between authors and panel of experts was used to prepare it.

The classification of the level of evidence and grading of the recommendations has been maintained while respecting the original source consulted and the scale of evidence that has been used. The method that CENETEC (National Centre of Technological Excellence in Health) of Mexico in the development of their clinical practice guidelines (GPC) has been used for this:

- Classify with the symbol **[E]** that evidence which is published in any GPC, followed by its alphanumeric classification (status of the study, if it is referenced) and bibliographic citation.
- Categorise with the symbol **[R]** those recommendations identified by any GPC, followed by their strength of recommendation (by levels A-B-C-D, in descending order according to clinical importance, or by their grading in high-moderate-low evidence).
- Identify with the symbol **[GP]** those actions and/or activities considered as good practices, which are not referenced or supported by any GPC, but that appear in other evidence-based documents (guides to good clinical practice, clinical pathways, evidence-based protocols based, etc.) and whose evidence has been obtained through systematic reviews, meta-analyses, clinical trials, etc.

The scales on the level of evidence and degree of recommendations that are described in the contents of this practical guide, can be consulted through the bibliographic sources referenced in the summaryTable of recommendations/evidence.

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HOW TO CITE THE DOCUMENT

Ameneiro Romero L., Arantón Areosa L., Sanmartín Castrillón R. *A practical guide to acute traumatic soft tissue injuries*. [Practical guide No. 8]. In: Rumbo Prieto J.M., Raña Lama C.D., Cimadevila Álvarez M.B., Calvo Pérez A.I., Fernández Segade J., editors. Collection of practical guides for wounds of the Galician Health Service Santiago de Compostela (A Coruña): Xunta de Galicia. Department of Health Galician Health Service, 2021.

02 INTRODUCTION

2.1. JUSTIFICATION

The approach to ulcers and wounds is a major health problem due to the extra financial cost to health systems, the loss of quality of life for patients, the impact that it has on their families and carers (who often bear the burden of prevention and care), and also due to the workload that this care supposes for health professionals. Therefore, making decisions about how to approach them requires taking into account various alternatives from different sources of information (clinical data, professional experience, patient preferences, scientific evidence, protocols, guidelines, etc.) which in turn lead to a considerable variability in decisions depending on the time, the information available and the person making the decision. This gives rise to a great disparity in the performance of professionals in techniques, tests and diagnostic skills, clinical judgement and decision-making when faced with the same problem or patient and even within the same professional in relation to patients with the same clinic and pathology.

This *Practical Guide for Acute Traumatic Soft Tissue Injuries* (practical guide no. 8) is part of the Collection of practical guides for injuries of the Galician Health Service; in accordance with the strategies and lines of action promoted through the Úlceras Fóra Programme coordinated by the General Sub-Directorate for Healthcare Management and Innovation. In turn, this collection, is also in line with strategy No. 10 (Improving clinical practice), of the 2010 Quality Plan for the National Health System, as well as, with Sergas 2020 Strategy:

This guide is a synthesis of the best available preventive or therapeutic interventions and practices aimed at acute traumatic soft tissue injuries; according to the most current evidence-based clinical practice.

2.2. SCOPE AND OBJECTIVES

The scope of the Guide is aimed at affected people, informal carers and all health professionals with direct or indirect responsibility for the comprehensive management of traumatic injuries, in any of the three levels of healthcare in the Community of Galicia: Primary Healthcare, Hospital Care and Socio-Health Care.

The aim of the guide is to have standardised guidelines and/or criteria that serve as a reference to identify risk factors, carry out specific actions for the prevention, detection, referral and treatment of acute traumatic soft tissue injuries that pose a health problem. The aim is to contribute to the welfare of people, reduce the variability of treatments and professional uncertainty, reduce the prevalence and incidence of this health problem in society, as well as achieve greater optimisation in the management of human and economic resources available to the Galician health and socio-health care system based on the recommendations of practice based on evidence-based practice recommendations and; achieve indicators of quality of care and patient safety that allow greater efficiency in the process between the different levels of care.

2.3. QUESTIONS THAT THIS PRACTICAL GUIDE SHOULD ANSWER

- What are acute traumatic soft tissue injuries and how are they defined?
- What causes them?
- What type are they and how are they classified?
- What are the most frequent locations?
- How can the risk of infection of acute traumatic soft tissue injuries be assessed?
- What measures must be implemented for proper healing?
- What treatments and/or therapeutic measures are most appropriate?
- What complications can occur?
- What prevention recommendations are the most appropriate?
- What treatment recommendations are the most suitable?
- What therapeutic and health education guidelines should patients, informal carers and professionals follow to facilitate their care?

03 DEFINITION

The term “trauma” includes all those injuries to tissues or an organ, produced by a violent action outside the body, whether of a mechanical, chemical, nuclear, thermal or electrical nature.¹

A traumatic injury is defined as an injury caused by an external traumatic agent, the violence of which may result in lacerations, incised wounds, puncture wounds, contusions and abrasions² with or without fractures.

It is defined as a traumatic soft tissue injury or wound with a break in the skin or mucous membranes, produced by an external agent that overcomes the resistance of the tissues on which it acts, and can affect subcutaneous cellular tissue, aponeurosis and muscles³ or other adjacent tissues.^{4,5}

This practical guide will use the term “traumatic injury” (from the Greek *traumatikós, traûma*)⁶ to refer to that injury produced by a mechanical agent, generally external, located in soft tissues with affectation and/or deterioration of the skin integrity.



Figure 1. Irregular wound in the lower third of the front of the leg

04 | EPIDEMIOLOGY

Traditionally, injuries due to traumatic causes were considered “accidents”, or random events, which generated a social “conformity” of considering them as inevitable.⁷ This concept has evolved in recent decades, and the most recent estimates show this type of injury as a “predictable”, “preventable” and “treatable” process; and their reduction (through social awareness and educational prevention strategies) as one of the major challenges for public health in the 21st century.⁸⁻¹⁰

Traumatic injury is one of the most most frequently consulted pathologies in the emergency services and points of continuous care (between 20% and 32% of the total care).^{11,12} It is also a frequent reason for consultation in primary care centres where it accounts for more than 50% of the care provided each year.¹³

Among the most common causes of traumatic injury to soft tissue are traffic accidents, domestic and work accidents, although one must also take into account blows from tumbles and/or falls, autolysis, and physical aggression, as well as sports, industrial and agricultural accidents, among others.¹⁴⁻¹⁶

In reference to soft tissue injuries, the upper limbs, abdominal area and face are the most affected anatomical regions in most cases.^{17,18} By age range, children are the most prone to suffer from domestic accidents or falls related to their intense physical activity and when playing games; it is also not an issue of minor importance in elderly people with mobility problems, which determines a large number of tumbles and falls, although in general, adults under 40 years, are the group of individuals who suffer most traumatic injuries (mainly due to traffic and work accidents), followed by the institutionalised elderly.¹⁹

As with other types of injury, the most important health problem that can occur in soft tissue trauma wounds is infection, mainly from *Streptococcus pyogenes* (*S. pyogenes*) and *Staphylococcus aureus* (*S. aureus*).²⁰ This also means an increase in health expenditure and an increase in morbidity and mortality in patients with this type of wounds.²¹

05 | PREDISPOSING FACTORS

The predisposing factors or determinants of suffering a traumatic injury are usually multiple and varied. Generally, simple trauma occurs unexpectedly and is caused by lack of awareness, carelessness, lack of proper training and/or lack of recognition that such a risk exists.²²

According to literature,²²⁻²⁵ simple injuries are produced, in 70% of the cases, by unforeseen causes such as: accidental impacts, accidental falls to different levels, traffic accidents (bicycles, cars, pedestrians...), accidents at work (cuts and falls to different levels), domestic accidents (minor burns and falls to the same level), animal bites and stings (dogs and cats), states of fragility (children and elderly), comorbidities (dizziness, vertigo), extreme weather conditions (heat stroke, rain, ice), etc.

On the other hand, it is estimated that in 20% of cases the predisposing mechanism is related to domestic violence, street assaults, assaults with knives or firearms, situations of abuse or mistreatment (child violence, gender violence); and about 10% is due to unintentional sports injuries (non-contact sports).

Depending on age, most injuries occur at extreme ages, between 0 and 15 years (over 10% of the child population) and those of 65 years or more. By their nature, falls without consequences (without sequelae or with minimal complications such as minor lacerations and bruises) are the most common group of traumatic injuries.

Statistically, gender can also be a determining factor in the frequency of suffering a trauma, with different incidences : among young people, it is men who suffer the most injuries, while in the over-65 age group it is women.

Illnesses, taking medication and vision are factors that have a greater impact on people aged 65 and over. Another significant fact is that 40%-50% of injuries seen in healthcare facilities involve the abuse of alcoholic beverages.

06 ETHIOPATHOGENY AND PHYSIOPATHOLOGY

6.1. ETHIOPATHOGENY²⁶

Traumatic wounds of mechanical aetiology are produced by so-called kinetic energy (movement), which affects cells, tissues, organs and systems, causing their pathological alteration. This mechanical energy is transferred by a solid object, liquid or gas, which are considered aetiological agents, causing traumatic injury due to the effect of three forces: Pressure Force, Traction Force and Shear Force.

Pressure and traction forces are perpendicular to the plane of the tissue, causing it to be crushed or elongated, respectively. Shear force causes the parallel and opposite sliding of the skin planes. Generally, the three forces are associated so as to impact on the tissues by means of kinetic energy (E) as a function of mass (m) and speed (v) as determined by the following formula: $E = \frac{1}{2}(mv^2)$.

The effect of this mechanical energy on the tissues can cause two types of alterations: functional and morphological.

- **Functional alterations:** are produced when a tissue absorbs such an amount of mechanical energy that it causes a decrease in tissue vitality (parenchymal and/or stroma injury). There are two types of alterations: reversible and Irreversible.
- **Morphological alterations:** this leads to tissue deformities that are in turn divided into elastic (regains shape) and inelastic or plastic (deformation persists). The maximum degree of deformation occurs when the tissue strength is exceeded and breakage occurs.

In practice, in a mechanical trauma, functional alterations are combined with morphological deformations, giving rise to two types of traumatic injuries:

- **Injuries without a break:** this injury is called **contusion**. A contusion is an acute tissue injury that will depend on the intensity of the mechanical energy produced by the aggressive action against the resistance of the tissue to the aggression (functional alteration). The contusion is categorised in 3 degrees: shock (1st), necrobiosis (2nd) and necrosis (3rd).
- **Injuries with a break:** these are produced by a break in the tissue that causes cell necrosis with loss of skin integrity. The tissue involvement will be delimited by the different tissues where the break is produced (skin, subcutaneous tissue or muscle). These types of injuries lead to **traumatic injury** and/or bone **fracture**.

6.2. PHYSIOPATHOLOGY

6.2.1. REPAIR PROCESS: WOUND HEALING AND EPITHELIALIZATION²⁷

The repair process of a wound takes place through wound healing and epithelialization and starts at the moment the injury is produced. It is a complex dynamic process, in which a set of synchronized and interdependent physiological mechanisms are activated for the reconstruction and repair of injured tissues. This set of stages overlap, are interconnected and are dependent on each other. When the depth of the wound affects only the most superficial layers of the skin (epidermis and superficial dermis), the lesions close by regenerating the epithelial tissue (no scar is left), so the resulting tissue has exactly the same characteristics as the original tissue before the injury; however, if the injury is deeper and affects the dermis, blood vessels and other internal structures, healing can no longer be by regeneration, but must be carried out through a scar.²⁸⁻³⁰

The stages that make up the repair process of a wound are:

- **Catabolic stage:** usually lasts until the sixth day of the injury. After the injury, if there is break in the skin, the edges of the wound separate and there is an outflow of blood resulting from the rupture of blood vessels, expanding throughout the cavity and coming out from the injury. A vascular contraction then occurs with clot formation and the bleeding stops. It should be noted that there may be an injury with no external bleeding, however, internal injuries with blood leakage into the extravascular space may have occurred, which may result in internal bruising (risk of compartment syndrome). Subsequently, local inflammation mechanisms are triggered, leading to reflex vasodilation (significant oedema may occur), acidosis, increased catabolism, protein degradation and exudative phenomena. A lysis takes place during this stage, in which different enzymes intervene to clean the wound of possible germs and bacteria that have penetrated the wound, its own cellular detritus and foreign bodies. Blood cells are also involved through phagocytic mechanisms.
- **Repair stage:** its direct objective is to close the break in the skin. A crust is formed from the exudates in the wound bed, which protects the wound from bacterial colonization and invasion and, by favouring retraction, brings the edges closer so they can join up. In very superficial wounds, the basal cells of the surrounding epidermis proliferate to cover the entire injured area. In deeper wounds or wounds with greater loss of substance, the wound bed is filled due to two phenomena: firstly, the formation of granulation tissue, and secondly, the retraction forces from the tissues surrounding the wound.

The granulation tissue is characterized by having reddish appearance and a mamelon (nipple) shape. It comes from the endothelial sprouting of the sectioned capillaries and from the proliferation of connective tissue fibroblasts. By mechanisms as yet unknown, once the wound bed is filled up, the granulation tissue stops growing and then, from the epidermal basal cells of the periphery, the wound becomes covered with epidermis, with the granulation process ending at this moment and then the epithelialization starts. The new scar tissue, which continues to evolve (mature), through degradation of the extracellular matrix and rearrangement of the connective tissue (which can last months or even years), never acquires a perfect anatomical shape, or the same consistency as the original tissue, as it is usually stiffer than the surrounding skin, lacks elastic fibres, hair follicles, sebaceous glands and sweat glands, so its tensile strength will be lower. The scar will be mature when the surface of the skin has reformed and practically

recovered its appearance and resistance to tension (strength). During this remodelling, the scar can evolve properly, reducing its extension, volume, consistency and colour, or evolve abnormally, resulting in pathological scarring.

6.2.2. CLINICAL EVOLUTION OF THE REPAIR PROCESS²⁷

Two types of scarring can occur, according to the clinical evolution of the cellular repair process of a wound:

- **Healing by primary intention:** this occurs when the edges of the wound are brought close together, usually through surgical suture, wound closure strips, or tissue adhesive. The repair process (scar) takes place in a minimum time, so it is usually an easier, faster and more aesthetic process (about 8-10 days). The incidence of healing problems is low and there are hardly any complications (tiny oedema). Reducing manipulation and changes of dressing correlates with reducing the risk of infection and optimizing healing time.
- **Healing by secondary intention:** this occurs when the edges of the wound remain separated. In these cases, connective tissue (granulation) should grow from the edges and bed of the wound, and is then covered by epithelium. It is usually a slower process, more prone to complications and with worse aesthetic and functional results (chronic appearance). Most wounds that are stitched and later infected, end up having to heal by this route, with the consequent increase in risks (chronification, slow healing evolution...).
- **Healing by tertiary intention or deferred primary healing:** this takes place when the closing of the wound is deferred. At first the wound is left open, and when uniform granulation and no sign of infection has been achieved, the edges are brought together with sutures.

6.2.3. FACTORS INFLUENCING THE REPAIR PROCESS^{27,29-33}

Local factors

- **Vascularisation:** a good supply of oxygen to the wound and an increase in local temperature will promote healing and epithelialization.
- **Presence of local infection:** this constitutes an important physical barrier to the development of granulation tissue as it prolongs the catabolic stage and delays healing. It usually causes skin necrosis with accumulation of detritus and necrotic debris. It should be noted that there may be situations where, even without clear infection criteria (no inflammatory signs and quantitative culture $<10^5$ uf/cm²), the lesion may present such a bacterial load that the progression towards epithelialization is inhibited or stagnated; this is known as critical colonization (the observation of other more subtle signs such as a sudden increase in exudate, the appearance of a bad smell, friability of the lesion bed, etc., is essential for its early identification).
- **The presence of haematoma:** they negatively affect the healing process, in that they make it difficult for blood to be supplied to the tissues; they can also act as a foreign body (encapsulated or encrusted haematoma) and also provide a breeding ground, which will increase the risk of infection.

- **Mechanical stress:** this is a negative factor for the evolution of the injury, since frequent handling of wounds delays epithelialization. Improper handling (rubbing granulation tissue from the lesion bed, washing or drying the bed) is also counter-productive.
- **Tension and external pressures:** this causes vessel collapse and local ischaemia. Sutures and/or tension strips and excessively compressive dressings should be avoided.
- **Wound size and alignment of edges:** If there is a greater loss of substance, there is a greater chance that the healing will be by secondary intention. Adequate attachment or joining of the edges will depend on them not being inverted or everted since this will slow down the epithelialization process.
- **Complexity of the wound, type of tissue and physical barriers:** the presence of foreign bodies, accumulation of liquids, dead spaces, irregular routes, fistulized or with devitalized tissue, detritus and necrotic remains in the wound, represent a physical barrier for the proliferation of granulation tissue, as well as favouring infection, thus delaying its healing.
- **Local application of drugs and chemical agents:** the use of corticosteroids or locally applied antibacterial products can inhibit and/or decrease the formation of granulation and epithelial tissue.
- **Inadequate technique when carrying out dressings:** excessive or improper handling, lack of asepsis or poor choice of dressings can also damage the granulation tissue already formed or being formed and delay the process.

Systemic factors

- **Age:** children and young people normally heal faster than adults and the elderly (in the elderly, lesions take longer to heal because they have a reduced capacity for cell proliferation and the necessary angiogenesis for resolution of the wound).
- **Nutritional status:**
 - **Proteins:** hypoproteinemia (albumin <3g % and transferrin <200g facilitates dehiscence of sutures, extends the catabolic stage, inhibits granulation and affects remodelling of the wound.
 - **Carbohydrates and fats:** glucose is an energy source for leukocytes in the catabolic stage. Lipids are part of the cytoplasmic membrane and are essential for cell multiplication processes.
 - **Trace elements:** copper, iron and magnesium are necessary for the synthesis of collagen. Manganese and zinc are enzyme cofactors that promote epithelialization and collagen resistance.
 - **Vitamins:** vitamin C promotes healing and antimicrobial defence. Vitamin A promotes collagen formation and epithelialization. Vitamin E has a similar effect to corticosteroids (anti-inflammatory effect). Others such as pyridoxine, riboflavin and thiamine act as co-factors for collagen formation.
- **Hormones:**
 - **Adrenal steroids:** act as immuno-suppressants by inhibiting the healing and epithelialization. Its antagonist is Vitamin A (dose of 25,000 U.).
 - **Insulin:** has an anabolic effect, promotes healing by helping the formation of granulation tissue.

- **Anaemic conditions:** a patient with haemoglobin deficit will see the oxygen supply to the tissues compromised, and therefore, the difficulty in healing will be greater.
- **Toxic habits:** the use of substances such as alcohol and tobacco can condition delays and/or complications in wound healing.^{34,35}
- **Systemic administration of anti-inflammatory drugs:** steroids inhibit the proliferation of fibroblasts, the formation of granulation tissue and epidermal regeneration; they can also activate the degradation of collagen (cyclosporine) or inhibit its synthesis (colchicine), so their use will delay the healing process.
- **Endocrine disruptions:** diabetic patients have a longer healing time than the rest of patients, because they show vascular alterations (peripheral arteriopathy); moreover, hormonal regulation and endocrine problems (corticoids, insulin...) will directly influence the healing process.
- **Systemic infection:** the effect of any infectious process with bacteremia on the body produces a catabolic increase that directly influences the healing process.
- **Ionising radiation:** inhibit the proliferation of granulation tissue.
- **Immuno-suppressive and cytotoxic drugs:** the use of cyclosporine A has steroid-like effects. It is advisable not to use it during the first 2 weeks of the healing process.
- **Coagulopathies:** factor XIII activates Thrombin, its deficit decreases or blocks the formation of fibrin, which is necessary for healing.
- **Dermatoporosis**^{36,37}: situation of skin ageing, expressed as a syndrome of skin fragility (chronic skin failure), inherent to the physiological process of ageing, which usually appears progressively from the age of 60 onwards and is most clearly seen between the ages of 70 and 90.

Dermatoporosis is characterised by:

- Reduction of epidermal and dermal thickness: thin and translucent skin.
- Signs of skin atrophy: drier, more fragile and wrinkled skin.
- Loss of skin elasticity due to the reduction of intradermal hyaluronic acid and the affectation of dermal collagen.

Dermatoporosis is classified into stages, according to its clinical manifestations, since the presentation varies greatly from one person to another:

- Stage I: this usually includes skin atrophy, the appearance of senile purpura with micro-haematoma, petechiae or ecchymoses and the formation of fine, whitish scars, known as stellate or star-like pseudo-scars.
- Stage II: "skin tears" or superficial flap lesions are produced secondary to minimal trauma on the skin.
- Stage III: characterised by the formation of lacerations, also derived from minor but more extensive and recalcitrant trauma.
- Stage IV: this is the most advanced stage and is characterised by the development of dissecting haematoma, which are subcutaneous haemorrhages caused by minor trauma, which can lead to ischaemia and necrosis.

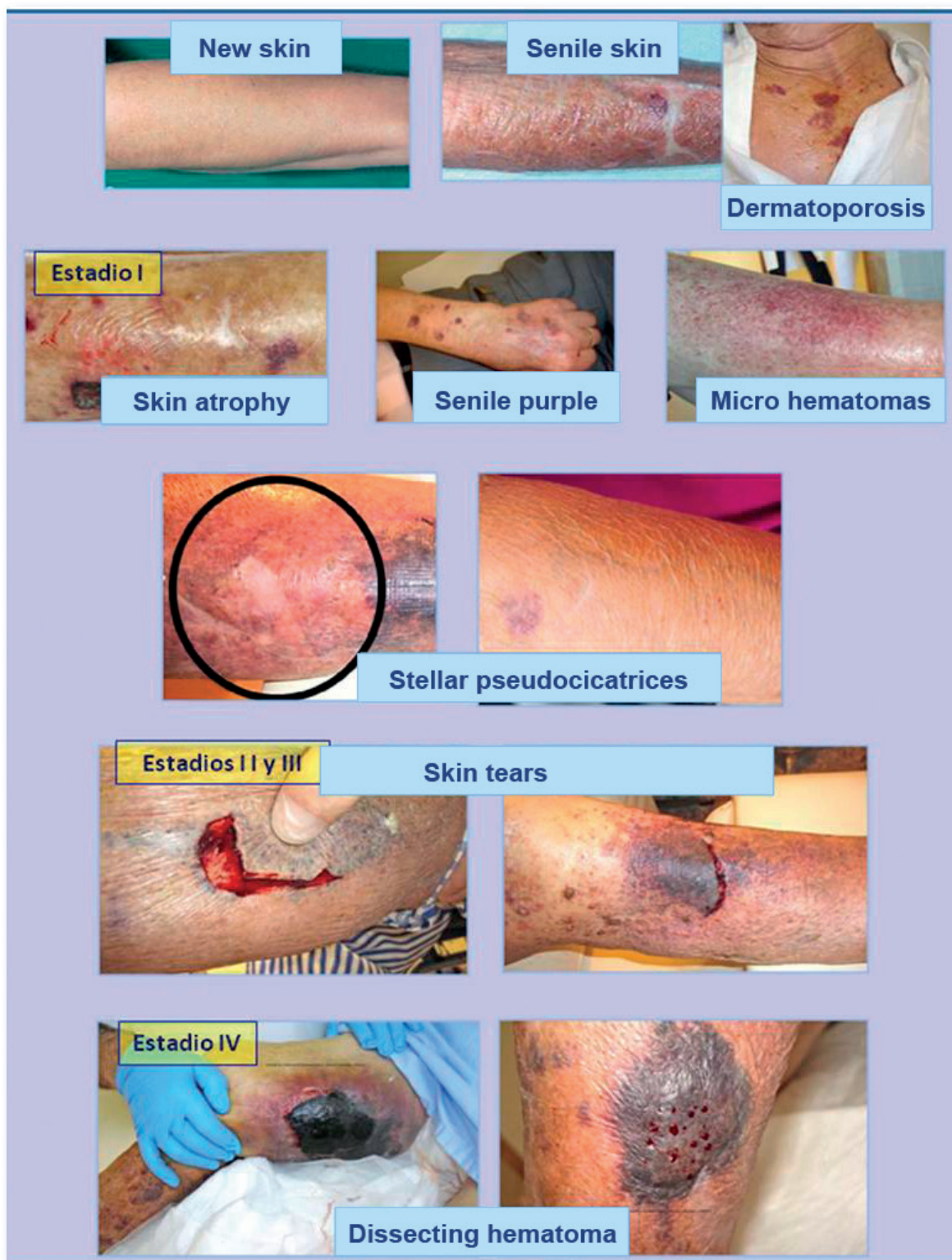


Figure 2. Dermatoporosis Differentiation and stages

STAGES	SKIN ATROPHY	SENILE PURPLE	PSEUDO SCARS	SKIN LACERATIONS	DISSECTING HAEMATOMAS
I	+	+	+	-	-
II	+	+	+	+	-
III	+	+	+	++	-
IV	+	+	+	++	+

Table 1. Dermatoporosis. Stages

6.2.4. LOCAL COMPLICATIONS OF THE REPAIR PROCESS:

PATHOLOGICAL SCARS^{27, 29-33}

We have already indicated that the healing process can be altered by various factors related to the patient himself, by the administration of certain drugs or products, by the absence of appropriate care or by the use of unsuitable manoeuvres. When the scar becomes hyperpigmented, reddened and thickened instead of flattening and becoming pale during the maturing process, this is called pathological scarring.

The **Normal healing process** is said to occur when an aesthetically acceptable scar is produced, which restores anatomical and functional integrity.

We establish that the **Healing process is pathological**, when that integrity is insufficient (the wounds become unstable or chronic), or when that repair is excessive, resulting in an overproduction of scar tissue.

Pathological scars are the most common local complications of the repair process (healing and epithelialization). They present some anomaly in their cell formation, which will have repercussions in aesthetic consequences, and functional and organic alterations, which could give rise to physical complications, depending on their size and location (limited joint movement, deformations, alopecia, etc.) and psychological complications (mainly if retractions occur in visible anatomical areas, leading to a body image disorder).

In the normal healing process, after epithelialization, the resulting scars are flat and linear; they gradually evolve in height and volume reaching a maximum level, and then flatten and become smooth again, reaching a baseline very similar to the initial status. The time needed to complete this process varies greatly from one patient to another, ranging from 6 months to 2 years (depending on the cause of the injury, how long the inflammatory phase is, the type of treatment, genetic predisposition, etc.). This indicates that one of the main aspects to assess if we are looking at a normal scar or a pathological one, is time; thus, before 6 months we will only be able to speak of an immature scar, which is active or in the remodelling stage, on which we could take preventive measures; but after 6 months we will formally speak of a pathological scar and consequently, we should initiate specific therapeutic measures.

The most common pathological scars are:

- **Hypertrophic scars:** they are characterised by being raised with a reddish colour, surrounded by normal skin. They have a tendency towards involution. This is a bulky tumour that usually appears in lesions that have had an extended inflammatory phase. They appear immediately after the injury is closed, remain limited to the area of the injury, and generally tend to flatten out as they progress. They are usually unsightly, with an irregular and dyschromic surface (alteration of the normal colour of the skin), with the presence of hard cords.
- **Keloid scars:** are bulkier and more raised, exuberant and very unsightly, spreading over nearby healthy skin, going beyond their natural boundaries. They usually cause itching, sensation of heat and pain when touched. The appearance of keloids is more frequent in the ear lobes, the pre-sternal area and in general the upper part of the thorax, frequently acquired in the pre-sternal area of women a butterfly-winged appearance, due to the

traction caused by the weight of the breasts. They occur due to an imbalance between collagen synthesis and degradation.

- **Painful scars:** have an innervation that makes them especially sensitive to any stimulus (sometimes painful episodes are related to weather or atmospheric changes). They can lead to vasomotor alterations, sympathetic irritation, vegetative disorders (hyperhidrosis or anhidrosis, heat and redness or coldness), muscle contractures, muscle atrophy, etc. (sometimes painful scars can correspond to keloid scars in the initial phase).
- **Scarring ulcers:** excessive or uncontrolled connective tissue proliferation can compress the skin capillaries, causing local ischemia as well as recurrent episodes of ulceration. In severe cases, this can degenerate into an epidermoid carcinoma. This is usually frequent in scars secondary to burns (Marjolin's ulcer).

Keloids and hypertrophic scars are the main exponents of the pathological healing process. These are entities exclusive to human beings and their incidence affects between 5% and 15% of wounds. There are numerous differences between the two pathologies (epidemiological and clinical elements), however, in practice, it is often not easy to differentiate between them, leading to confusion. The main difference to be highlighted is that the hypertrophic scar remains within the limits of the original scar, and that a keloid scar extends beyond these borders behaving almost like a scar neoplasm.

07 | CLASSIFICATION OF THE TRAUMA INJURIES

Most classifications of trauma injuries are merely descriptive (direction, form, or producing agent), but not very useful for therapeutic decisions.

For this guide we have taken those classifications that help the professional to decide the treatment that must be carried out, so the criteria of macroscopic aspect, complexity, depth and relationship with body cavities are followed.

Macroscopic appearance³⁸

- **Clean:** any non-infected wound, less than 6 hours old (except in specific regions such as the face, where the period may increase to 12 hours) with a bleeding background, no foreign bodies and/or necrosis.
- **Dirty:** any wound where there are foreign bodies, devitalised tissues or that occurred more than 6 hours ago.

Degree of complexity³⁹

- **Complex:** affect internal structures (tendons, nerves, arteries, etc.).
- **Simple:** other wounds.

Depth³⁹

- **Superficial:** affecting skin and subcutaneous cellular tissue (lacerations).
- **Deep:** affect beyond subcutaneous cell tissue.

Relationship with body cavities³⁹

- Penetrating wounds are those that can cause injury to internal organs and that can compromise the patient's life (haemorrhage, pneumothorax, etc.).



Figure 3. Clean wound in the abdomen, without affecting deep planes and with less than 6 hours of evolution



Figure 4. Dirty wound on foot, affected by deep planes and hours of evolution

08 | ANAMNESIS. EXAMINATION

8.1. ANAMNESIS

A proper anamnesis should always be taken when dealing with a patient who has suffered a trauma injury:

1. Ask about **drug allergies**, with emphasis on local anaesthetics, antiseptics, antibiotics, analgesics and anti-inflammatory drugs.
2. **Personal background** of interest (with an emphasis on those that increase the likelihood of healing problems and increase the risk of wound infection): diabetes, immunosuppressive drugs, IV drug addicts, carriers of resistant germs...
3. Question about the status of **tetanus vaccination** (see section 7.12).
4. Know the **mechanism of injury** and the **environment** in which the injury occurred. Literature confirms that exposure to different environments or various work activities predisposes wounds to infection/colonization by different germs⁴⁰:
 - Injuries from exposure to fresh water: *Aeromonas spp.*
 - Wounds exposed to salt water: *Vibrio vulnificus*.
 - Butchers, veterinarians, and livestock farmers: *Erysipelothrix rhusiopathiae*.
 - Puncture wound on the sole of the foot: *Pseudomonas aeruginosa*.
5. Identify the **evolution time** of the wound, since it conditions the procedure to follow:
 - Traditionally a clean wound³⁸ wound was considered as any wound that was not infected and with less than six hours evolution (except in specific regions such as the face, where the period could be increased to 12 hours), where primary suturing could be performed.
 - Any one, in which the evolution is between 6 and 12 hours, is a contaminated wound where primary suture could be performed or not. If the decision is made to perform primary closure, it will require closer monitoring, due to the higher incidence of complications. A wound attended to after 12 hours will be considered an infected wound, where a primary suture will not be performed, requiring closure by secondary intention. Antibiotics will be required.
 - This classification appears in many publications; however, in the Cochrane review⁴¹ it is concluded that there is no systematic evidence to guide clinical decision-making regarding the appropriate timing of closure of trauma wounds within the first 24 hours.

8.2. EXAMINATION

Mobility and sensitivity of the distal areas to the wound should be assessed to rule out tendon or nerve section. The findings of the examination should be reflected in the clinical history, emphasizing the existence of neurovascular involvement or not, prior to local anaesthesia.

In the event that it is considered necessary to carry out a thorough exploration of the wound to assess the effect on deep planes, it will be necessary to perform an anaesthetic block beforehand, which will allow us to determine the extent of the lesion with the least possible discomfort for the patient.

Instrumental exploration of the lesion with probes or stylets is not recommended. This is a dangerous manoeuvre, where we can produce secondary injuries, as well as favouring bacterial contamination.

If bone involvement is suspected, an x-ray study should be performed prior to suturing the wound.

09 | TREATMENT AND INITIAL APPROACH

This section is presented following each step of the therapeutic decisions that must be taken in the treatment of traumatic wounds.

9.1. POSITION OF THE PATIENT

The treatment should be carried out with the patient **lying down** on a stretcher. Even if the wound is in an anatomical area that is easily accessible and allows the patient to be seated, it is not advisable to wash and close the wound in that position, because of the risk of suffering a reflex syncope.

9.2. CLEANING THE WOUND

A very important step in the treating of wounds, to decrease the incidence of infections, especially in dirty or complicated wounds, is **irrigation**.⁴²

Although various solutions have been recommended for cleaning of wounds, the use of a saline solution (SS) is preferred as it does not interfere with the normal healing process. High quality tap water (potable) between 30°-35° can be used, which can be as good as other methods such as sterile water or saline water, and is more cost-effective.⁴³⁻⁴⁶

In this wound cleansing step, adding povidone-iodine to water or saline solution does not improve the infection rate with respect to water/saline solution without antiseptic or even with the non cleaning of the simple uncontaminated wound.⁴⁶ However, polyhexanide (PHMB) irrigation shows high efficacy in preventing infection in traumatic soft tissue wounds, compared to povidone-iodine, but only significantly exceeds it in superficial infections.⁴⁷

During irrigation, the pressure should be moderate (20 ml syringe with 22G needle or directly with the 500 cc container of saline solution).⁴⁸

If the wound is dirty or contaminated due to foreign bodies (grass, soil...), the irrigation action should be repeated after local anaesthesia, together with cleaning using a surgical brush and instrumental removal of foreign bodies. Regularly used antiseptic soap solutions are only recommended for use on intact skin and their use on mucous membranes or wounds is discouraged, so it is recommended they be used to clean perilesional skin when there is a lot of dirt and then rinsed with plenty of SS or water.

9.3. SHAVING

It will not be necessary shave the perilesional area⁴⁹ except if the view of the wound needs to be improved for suturing. It is preferable to cut the hairy areas with scissors or an electric razor instead of shaving them.

9.4. HAND WASHING

The steps for hand washing should be followed and can be done with **soap and water** or with **alcoholic solutions**:

<https://www.sergas.es/Saude-publica/Documents/1516/LavadoMansXabon.pdf>

<https://www.sergas.es/Saude-publica/Documents/1517/LavadoMansAlcohol.pdf>

9.5. STERILE GLOVES

Handling the skin area with a solution of continuity, as is the case with traumatic wounds, makes it necessary to use sterile gloves.⁵⁰

9.6. ANTISEPSIS OF THE WOUND

In clinical practice there are multiple antiseptics that can be used in perilesional skin asepsis prior to local anaesthesia and suturing (**Table 5**). At this point the importance of following the recommendations of the antiseptic's technical data sheet for its correct use should be emphasised, taking into account the time the action is started and contraindications.

Following the latest international recommendations,⁵¹ the skin should be prepared by wiping the edges of the wound with one of the following antiseptics:

- Polyhexanide (PHMB): recommended **with level A** as a therapeutic option for acute trauma/injuries.
- Combination 0.1% octenidine hydrochloride + phenoxyethanol (OCTENISEPT® solution), is suitable for acute, contaminated and traumatic wounds, including wounds colonized by MRSA, due to its deep action.
- Sodium Hypochlorite / Hypochlorous Acid (NaOCl or NaOCl/HOCl), are first choice for simple or repetitive intensive antiseptic cleaning of contaminated traumatic wounds.
- Povidone-iodine (PVP-I): a systematic review⁵² concludes that PVP-I should not be used in the treatment of chronic wounds and there is also a lack of evidence for the use of PVP-I as a cleaning solution for the prevention of infection in acute traumatic soft tissue injuries.⁴⁷ However, in combination with alcohol, PVP-I remains the agent of first choice for the prevention of infection in acute stab, cut, bite or gunshot wounds due to its ability to penetrate deep into the wounds.⁵³ Its excellent tissue penetration makes PVP-I (only water-based!) a candidate for use on heavily destroyed tissue from traumatic injuries, such as those resulting from traffic accidents or explosions.

9.7. STERILE DRAPE

If the wound is considered clean, and no further washing is required, a sterile field should be put in position, using either a fenestrated drape or 2-3 non-fenestrated drapes.

If the wound is dirty or contaminated by foreign bodies, after local anaesthesia, a new irrigation and antiseptics of the wound edges will be needed, after which the sterile field will be created.

9.8. LOCAL ANAESTHESIA

In most cases, local anaesthesia will be used to suture the traumatic wounds. In some circumstances (children, repair of complex wounds...) regional anaesthetic blocks, sedation or general anaesthesia will be needed instead of local infiltration.

9.8.1. LOCAL ANAESTHETICS. GENERAL CONSIDERATIONS

Local anaesthetics act by inhibiting the nerve impulse, resulting in the loss of painful sensation.

Local anaesthetics are classified into 2 groups according to their chemical composition, as specified in [Table 2](#).

- **Group I - Esters:** Restricted to use in topical forms or in case of allergy to local anaesthetics of the amide group.⁵⁴⁻⁵⁷
- **Group II - Amides:** The most common local anaesthetics in clinical practice belong to this group.

GROUP I - ESTERS	GROUP II - AMIDES
Benzocaine	Articaine
Chloroprocaine	Bupivacaine - Vm 4 hours
Cocaine	Levobupivacaine
Procaine	Cybucaine
Proparacaine	Etidocaine
Tetracaine	Lidocaine - Vm 40-60 min
	Mepivacaine - Vm 40-60 min
	Prilocaine
	Ropivacaine

Table 2. Classification of local anaesthetics. The most widely used in clinical practice are highlighted in bold type, with the average time of action (Vm)

Both lidocaine and mepivacaine have a rapid onset of action (2-5 minutes) and an intermediate half-life (40-60 minutes). However, the onset of action by bupivacaine takes 10 minutes, and the average duration is about 4 hours.

The association of vasoconstrictor (epinephrine 1:1000/ 1:2000) and local anaesthetics, delays systemic absorption and therefore decreases its plasma concentration, improving safety, reducing local bleeding and the onset of action is faster and the duration of its effect greater.⁵⁴

In the past, the use of a vasoconstrictor in distal areas such as the fingers, penis, nose or auricle was discouraged. Basic scientific and clinical studies have shown that epinephrine can be used in these locations.⁵⁷

Local anaesthetics are in the form of hydrochloride salts (pH=6). The acidic pH explains the stinging and burning sensation they produce when infiltrated. The pH drops by associating a vasoconstrictor, which makes the infiltration hurt more.

In children, for superficial wounds without complications, some authors⁵⁸ advise the use of topical anaesthetics, like LET[®] gel (lidocaine, epinephrine, tetracaine).

Contraindications to local anaesthesia

- **Allergy** to local anaesthetics: allergy to a particular local anaesthetic is a contraindication to the use of all anaesthetics in its group (esters or amides). The administration of the other chemical family is usually safe, except in the case that the clinical symptoms were anaphylactic in the previous allergy.
- **Large and/or multiple injuries**, where the required dose of local anaesthetic is close to or exceeds the maximum permitted dose.⁵⁹

Contraindications to the presence of vasoconstrictors

- Patients with underlying diseases (hyperthyroidism, pheochromocytoma, severe hypertension, coronary disease) that may be aggravated by the systemic effects of epinephrine.
- Digital anaesthesia in patients with compromised arterial circulation.
- Periorbital infiltration in patients with narrow angle glaucoma.
- Patients with catecholamine sensitivity.
- Patients taking rye ergot alkaloids such as ergotamine for vasoconstrictive effect and elevated blood pressure.
- Patients taking beta-blockers (less risk with cardioselectives), monoamine oxidase inhibitors (MAOIs), phenothiazides, and tricyclic antidepressant.

9.8.2. LOCAL ANAESTHETIC INFILTRATION TECHNIQUE

Material:

- Antiseptic solution:
 - 2% aqueous chlorhexidine if the wound is infiltrated, alcoholic chlorhexidine if the entire skin is blocked with anaesthetic.
 - Povidone Iodine 10%.
- Sterile gauze.
- 25-27 G subcutaneous hypodermic needle (sc).
- Syringe (2, 5 or 10 ml).
- Saline and sterile container (if local anaesthetic needs to be diluted).
- Local anaesthetic (commercial presentation with or without vasoconstrictor).

Steps:

- Confirm the absence of a history of allergy or adverse reaction to local anaesthetics.
- Explain to the patient what the procedure is going to consist of.

- Preferably with the patient in a recumbent position.
- Ensure that distal areas do not show neurovascular involvement.
- Use aseptic technique.
- Decide on the local anaesthetic to use (depending on allergies, onset of action and half-life. Decide whether to use a vasoconstrictor).
- Consider measures to reduce the pain of the injection.
- Use a short bevelled needle, as fine as possible and of the appropriate length for the technique to be performed.

The **wound infiltration** can be carried out in two ways

1. Directly on the lesion: this can be used on clean or superficial wounds. A puncture is made on the edge of the wound.
2. Outside the lesion: blocking of the perilesional area. This should be used on contaminated wounds or abscesses. A needle puncture is carried out through the clean skin at the edge of the contaminated wound.
 - Slowly perform manoeuvres of putting the needle in and withdrawing it.
 - Administer the local anaesthetic slowly, frequent aspirating (checking that we are not in a vascular bed) and injecting small amounts of local anaesthetic, avoiding forced injections at high pressures.
 - Anaesthetise the adjacent areas by puncturing the already anaesthetised area, thus avoiding the pain of the needle going in.
 - If a puncture results in paresthesia, stop the administration and move the needle until it disappears.
 - Wait a few minutes before beginning thorough washing or suturing. The effectiveness of the anaesthesia can be checked with the injection needle or another sharp object.
 - Explanations will be given to the patient that full recovery of sensation is expected shortly after the procedure, and the exact time will depend on the type of local anaesthetic used.

The techniques that can reduce pain associated with the injection are the following:⁶⁰

- Distracting the patient (especially for children).
- Hide the needle from view before and during the injection, especially in children.
- Warm the local anaesthetic to body temperature before the injection (**Degree of evidence II A**), between 34 and 37 degrees.
- Apply gentle pressure to the injection site.
- Use small needles (25-27 G or even 30 gauge).
- Subcutaneous injection (not intradermal).⁶¹
- Alkalinise the solution without causing it to precipitate, diluting the local anaesthetic in solutions with calcium such as Ringer lactate or acetate, or associating lidocaine with sodium bicarbonate (never mepivacaine or bupivacaine) (**Degree of evidence IIA**).

- Slow speed of injection and use of small volume syringes to reduce the pressure of the entry of liquid.

9.8.3. COMPLICATIONS OF LOCAL ANAESTHESIA

- **Local:** the most common. Pain, haematoma, infection and injury of subcutaneous structures. The likelihood of these complications decreases with careful technique.
- **Systemic:**
 - **Central Nervous System (CNS):** the first sign of CNS involvement is a **metallic taste**, followed by tinnitus, then tingling on the lips, agitation and convulsions. Treatment: oxygen therapy, maintaining the airway and vital signs, benzodiazepines (IV or rectal - Stesolid®) and refer to a hospital.
 - **Cardiovascular:** bradycardia, A-V block, hypotension, shock and ventricular arrhythmias. Treatment: Cardio-pulmonary resuscitation protocol.
- **Complications from allergy to local anaesthetics:**
 - **Contact dermatitis:** local and pruritic eczema at 72 hours in the area that has been in direct contact with the local anaesthetic.
 - **Anaphylaxis:** hives, facial or intraoral oedema, stridor, wheezing, hypotension. Treatment: Adrenaline (0.3-0.5 mL/kg of weight, in children 0.1 mL/kg).
- **Other complications:**
 - **Sensitivity to catecholamines:** tachycardia, hypertension and anxiety, in those where epinephrine is used. Avoid the use of a vasoconstrictor associated with the local anaesthetic in the future.
 - **Vasovagal syndrome:** bradycardia and pallor. Prevention: relaxing the patient, performing the technique with the patient in decubitus, not allowing them to see the infiltration, adequate room temperature...

9.9. FRIEDRICH- EXCISION OF THE WOUND

Removing necrotic debris eliminates part of the micro-organisms, it is not necessary in simple wounds, but it is an essential act in **contaminated wounds** (and is completely contraindicated in infected wounds).

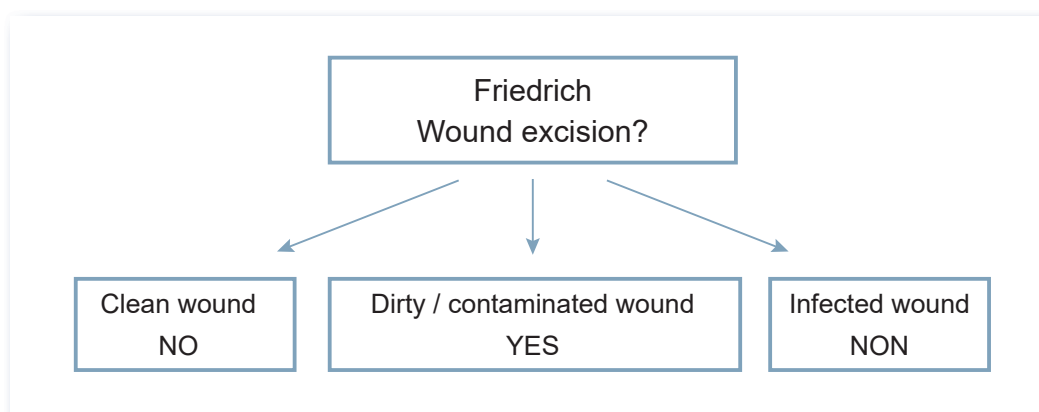


Figure 5. Diagram for the removal of necrotic debris depending on the type of wound

The most suitable excision technique is block removal of the wound, but this is not always possible so in these cases one should start from the outside in. The order is:

- remove skin edges of 2 mm thickness or more, if there are very bruised edges.
- the subcutaneous tissue of 2 cm or more thickness can be removed.
- the muscle is generously removed until bleeding and contractile edges are achieved.

Excision is not advisable for aesthetic and functional reasons on the face, neck and scalp. On hands, the exeresis of tissue should be the essential minimum just to refresh the edges.

9.10. CLOSING THE WOUND

After thorough cleaning of the wound, the appropriate treatment should be decided: suture (primary or deferred primary) or healing by secondary intention.

The **primary suture** shortens the repair time (scarring occurs by primary intention), decreases the risk of secondary infection, leaving more aesthetic and functional scars. So whenever possible, a primary suture will be chosen.

What is the ideal window period for primary wound closure?

As already mentioned, traditionally, based on a hypothetical increased risk of infection, deferred closure was recommended in wounds with an evolution of more than 6 hours, however, we now have evidence to support primary closure in much longer periods. In the latest reviews, it is concluded that wounds produced by clean and sharp objects can be postponed by first intention until 12-18 hours from the time of injury,⁶² if this occurs on the trunk or proximal extremities and if there are no other risk factors for delayed healing or infection.

There are wounds that occur in healthy patients, which allow primary repair to be delayed even beyond 20 hours. An example would be a clean wound on a patient's face with no risk factors, which can even be assessed as primary closure 48-72 hours after the injury, if the edges of the wound are easily brought together.⁶³

On the other hand we find wounds at risk of infection, such as contaminated wounds or those that occur in lower limbs with vascularization deficit or in patients with some type of immunosuppression, where they can be closed by primary intention after thorough cleaning within a period of 6 to 10 hours.⁶³

Contraindications for primary suture are those where there is a high probability of contamination:

- Intense contamination and foreign bodies.
- Irregular trajectories and a large component of contusions and tissue attrition.
- Suspicion of highly pathogenic germs (e.g. bites) or in immuno-suppressed patients.
- Delayed treatment (>24 h).
- Association with ischemia (associated vascular section or compartment syndrome).
- When the evolution of the wound cannot be followed.

In these cases of contraindication for primary suture, the decision can be made for **secondary healing** (where the wound is left open, allowing growth of granulation tissue and later epithelialization) or where a **delayed primary suture** can be carried out (healing by tertiary intention), where initially the wound is open and covered with a sterile dressing, and after a period (3-5 days), if there are no signs of infection, it is sutured.

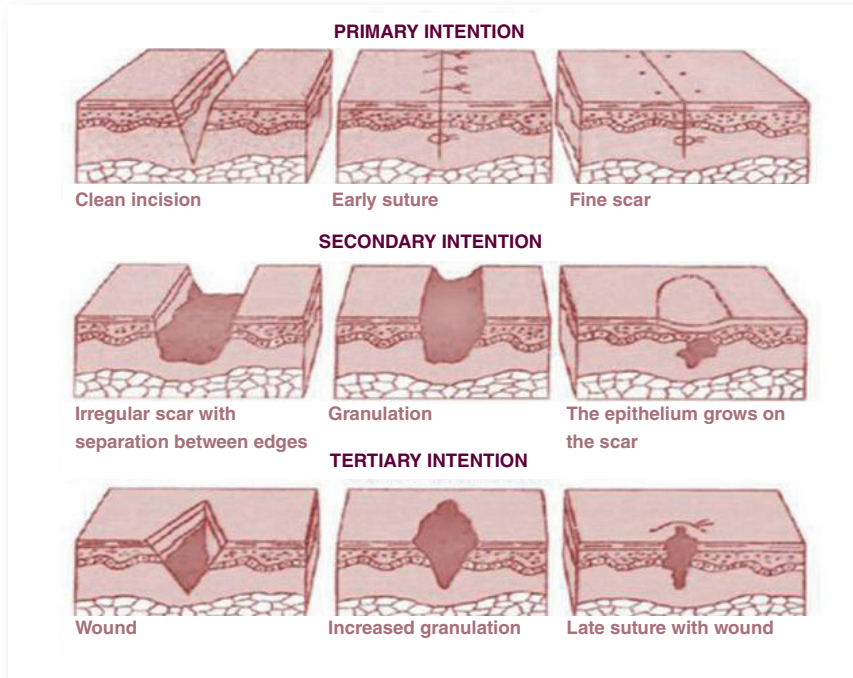


Figure 6. Classification of the healing (Image source: López de los Reyes R, et al.⁸³).

HEALING BY PRIMARY INTENTION Primary suture	HEALING BY SECONDARY INTENTION Healing by secondary intention	HEALING BY TERTIARY INTENTION Deferred primary suture
<ul style="list-style-type: none"> • This occurs when an immediate surgical approach is carried out to the edges of the wound by means of any type of sutures, staples, or adhesive devices, as well as that made by flap or graft. • Closing must be done by anatomical planes. • At 48 hours there is a protective barrier that isolates the wound from contamination by external agents. 	<ul style="list-style-type: none"> • Spontaneous closure of the wounds. • The wound is left open, with the growth of granulation tissue starting and then epithelialization of the wound. 	<ul style="list-style-type: none"> • Delayed closure or late primary healing. • At first the wound is left open, and when there is uniform granulation tissue and no signs of infection, the edges are closed by sutures.

Table 3. Relationship between healing classification and types of suture



Figure 7. Primary suture of the wound with palmar zone where healing is performed by secondary intention



Figure 8. Example of deferred primary suture: The wound is left open (in this case with Vessel-loop/seton) to be progressively closed and after 3-5 days, the sutures are carried out

9.10.1. SUTURE MATERIAL

- **Tissue adhesives:** sutures are significantly better than tissue adhesives at minimizing dehiscence⁶⁴ but there is the possibility of using this type of adhesives in lacerations (superficial wounds) without tension in children, due to the fact that they are applied more quickly and are also less aggressive than sutures. Among the tissue adhesives butylcyanoacrylate (Histoacryl®) and octylacrylate (Dermabond®), no significant difference in aesthetics, pain, procedure time or complications has been found in paediatric facial lacerations.⁶⁵
- **Surgical plaster:** (Steri-strip® type) can be used in linear, tension-free lacerations or as support for other types of sutures (e.g. intradermal sutures).
- **Staples:** easy to use, less time is needed and do not produce any tissue reaction.

- **Suture threads:** we must differentiate between absorbable and non-absorbable. And within the absorbable ones there are different types according to the time they take to be absorbed.

In general, **absorbable are for deep tissues** and **non-absorbable for skin**. Absorbable threads can be used at skin level in wounds that do not require support for more than 7-10 days⁶⁶ (Vicryl Rapide® - polyglactin), but this type of fast-absorbing sutures should never be used in vessel ligatures.

Sutures can also be differentiated between braided or monofilament. Braided thread is made up of several threads, providing greater tensile strength and flexibility. Monofilament, made from a single strand, finds less resistance when passing through the tissue, but must be handled with great care because of the risk of breakage; it also has a lot of memory, which makes it more difficult to knot and the knot is more likely to unravel, so it is always advisable to make more knots to safely block the sutures. Monofilament produces less tissue reaction and appears to have less risk of infection.⁶⁷ For all these reasons, there is a tendency to use **monofilament in aesthetic areas (face)** or with increased risk of adhesions or infection, and **braided** when **greater support/tension is required**.

Another difference is the size (thickness) of the suture, which in Europe is expressed in zeros (the more zeros, the smaller the size of the thread). As a general rule, the smallest possible thread should be used to maintain the tension and closing the wound's edges. Depending on the type of wound and the area where it occurs, a different type and size of sutures is recommended.

We must bear in mind that all this information associated with a lot of other information (type of needle, length of thread...) appears on the packaging of all the sutures.

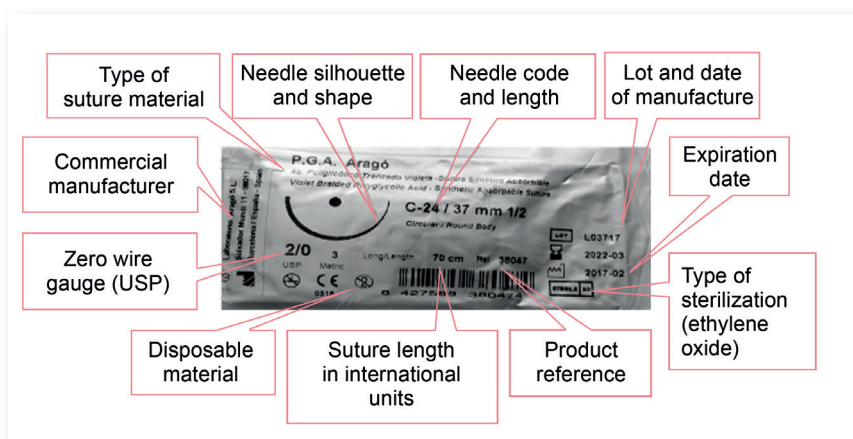


Figure 9. Description of the suture information on the package

ANATOMICAL REGION	SKIN SUTURE	DEEP SUTURE	SPECIAL CONSIDERATIONS	SUTURE REMOVAL (DAYS)
SCALP	3/0 NA Staples	3/0 RA	If important detachment -carry out compressive bandaging	7-9
EAR LOBE	5/0 NA	5/0 RA	If there is cartilage involvement - risk of necrosis	4-6
EYEBROW	6/0 NA	5/0 RA		4-5
EYELID	6/0 NA	5/0 RA		4-5
LIP	6/0 NA	Mucosa-4/0 RA Subcutaneous-5/0 RA	If deep laceration, perform closure on 3 planes	4-6
ORAL CAVITY		4/0 RA	On tongue close by planes	Until reabsorption
FACE	6/0 NA – monofilament On forehead 5/0 NA	5/0 RA		4-6
NECK	5/0 NA	4/0 RA		4-6
TRUNK	4/0 NA	3/0 RA		Abdomen 7-12 Back 12-14
LIMBS	4/0 NA	3/0 RA	Location on joint - splint	8-14
HANDS AND FEET	4/0 NA		Location on joint - splint	8-12
NAIL	Nail bed 5/0 RA or nothing		Replace the nail under the cuticle	Until reabsorbed

Table 4. Recommended type and size of sutures according to the anatomical region where the wound is located (NA: not absorbable; RA: Absorbable)

9.10.2. SUTURE TECHNIQUE

If it has been decided to carry out the closing of a wound using sutures, the following material is required:

- Sterile gloves.
- Drapes for the surgical field.
- Needle holder.
- Sterile gauze pads.
- Serrated/non-serrated tweezers.
- Scissors or scalpel blade for cutting the thread.

The next step is to decide what type of suture is to be undertaken, taking into account that it must be made by planes. The suture of subcutaneous tissue aims to close the original cavity and fix the underlying tissue to avoid the appearance of dead spaces and accumulation of bruises and seromas.

9.10.2.1. CONTINUOUS SUTURE

The stitches are carried out continuously without cutting the thread, so it is carried out faster, but also produces more tension and ischemia. As there are no separate points, they must all be removed together. In addition, this type of suture makes it difficult to drain the wound and is

contraindicated if there is a suspicion of infection. An intradermal suture is a type of continuous suture that has a good aesthetic result and should only be used if there is a minimal chance of infection of the traumatic wound. If you decide to use this type of suture, you must perform it with a monofilament.

9.10.2.2. DISCONTINUOUS SUTURE

They are the most used. Each stitch is independent from the next and a more secure closure is produced. They should be distributed evenly along the wound, since in case one of the stitches fails, the rest will continue to close the edges. It allows drainage and suture removal is easier. It can be used on infected wounds.

- **Simple stitch:** the simplest and most widely used. The needle is inserted perpendicular to the skin and the stitch is as wide as it is deep. The entry and exit points on the opposite side should be approximately the same distance from the wound edge (2-3 mm from the edge in facial wounds and 3-5 mm in other locations).⁴⁸
- **Single stitch with buried or inverted knot:** is used in the subcutaneous tissue.
- **Horizontal or vertical mattress suture:** in wounds that require tension for closure, and in non-homogeneous edges and for block sutures.
- **Pulley stitch:** which can be used for primary closure of scalp wounds.⁶⁸



Figure 10. Simple stitch



Figure 11. Inverted knot

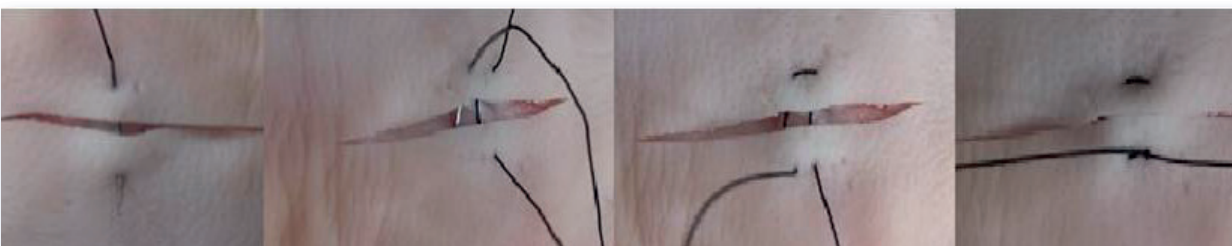


Figure 12. Horizontal mattress stitch

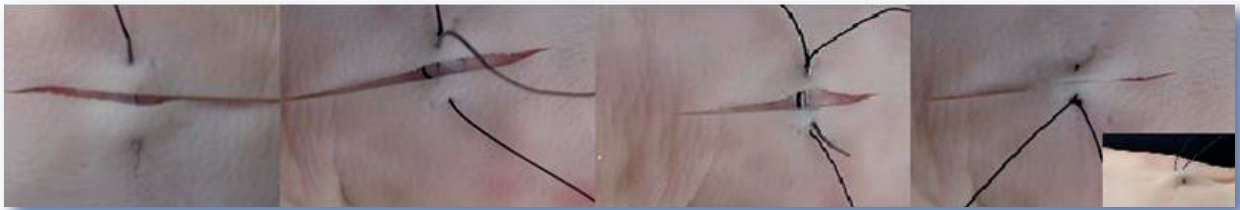


Figure 13. Vertical mattress stitch

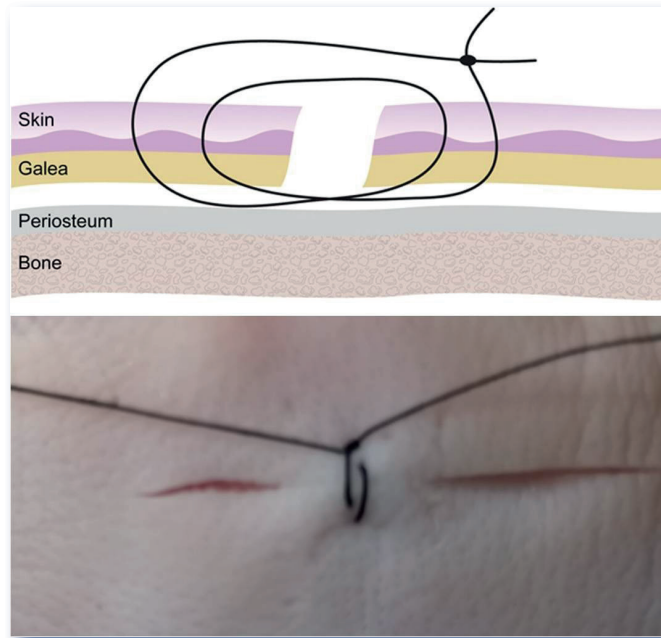


Figure 14. Pulley stitch

9.10.3. SPECIAL WOUNDS. PECULIARITIES OF THE REPAIR

- **V-shaped or sharp-angled lacerations.** This type of wound is sutured using the three-point or half-buried mattress technique with the intention of reducing the possibility of vascular necrosis that could appear at the apex of the wound.
- **Bevelled wound or skin flap.** In this type of wound there is a thin flap of skin with a lowered edge and less blood supply, which has a high probability of necrosis due to poor irrigation. In these cases, the wound edges are trimmed and aligned.
- **Wound in a flesh part with loss of substance.** There are multiple flaps that can be carried out to cover the area of skin loss. But if neither the bone nor the tendons are exposed, healing by secondary intention is a very good alternative.



Figure 15. Half-buried mattress suture. The apex point of the flap is in the subcutaneous tissue

9.10.4. DRAINS

A drain will not be needed in most traumatic injuries. The drainage system is a foreign body for tissues, and it behaves as such, worsening tissue resistance to aggressions and favouring the retrograde diffusion of contaminants from the skin.

It would be indicated for those wounds with high risk of infection, ample tissue detachment to avoid accumulation of seroma or haematoma, and in those with the possibility of abundant bleeding due to difficulty in performing adequate hemostasis.

The placement of drains is not without complications,⁶⁹ so it should be noted that a careful suture technique and obliteration of the dead space by plane closure eliminates the need for drains.

9.11. ANTIBIOTICS

The best way to prevent infection of the traumatic wound is to carry out adequate cleaning early on, with removal of foreign bodies and deep debridement of the devitalised tissues.⁷⁰

For decades, there have been publications claiming that there is no evidence that antibiotic prophylaxis in uncomplicated wounds protects against infection,^{71,72} however, a high percentage of professionals continue to use prophylactic antibiotic therapy on these types of wounds. This is probably secondary to the fact that there are no proper studies that make this point sufficiently clear.^{41,73,74}

It is demonstrated in literature that simple skin, tongue and intraoral lacerations do not benefit from antibiotic prophylaxis when not associated with fractures.⁶⁹

There may be some situations where antibiotics are appropriate:⁷²

- Immuno-suppressed patient.
- Puncture or crush injuries.
- Open fractures or intra-articular injuries, or those involving the bursa.⁷⁵
- Wounds affecting tendons or cartilage.
- Contaminated wounds that could not be properly cleaned.
- Bites.
- Wounds with significant delay in treatment (>12 h).

In the case of using antibiotics, these guidelines should be followed:

- Do not use a topical antibiotic.
- Intravenous is best.
- Single dose.
- Highest recommended dose.
- As soon as possible after the trauma.
- If blood loss is greater than 1 litre or more than 4 hours, new dose.

Type of antibiotic to be used:

- **1st generation cephalosporins.**
- **Amoxicillin:** covers gram-negative, gram-positive and some anaerobes. In those allergic to penicillin: **Clindamycin 600 mg.** It can be used orally, but antibiotic prophylaxis does not need to be maintained beyond **48 hours.**^{72,76}

9.12. TETANUS PROPHYLAXIS⁷⁷

What are injuries that could be subject to tetanus?

- Wounds or burns with a significant degree of devitalised tissue.
- Puncture wound (particularly if there was contact with soil or manure).
- Wounds contaminated with a foreign body.
- Chronic ulcerated skin lesions, especially in diabetic patients.
- Open fractures.
- Bites.
- Injuries due to freezing.
- Wounds that require surgery and are delayed for more than 6 hours.
- Wounds that occur in patients with sepsis.
- High-risk wounds: wounds that might be subject to tetanus are those contaminated with large amounts of material that may contain spores or have large areas of devitalised tissue.

When and how should tetanus prophylaxis be carried out?

Vaccination history	Clean wound	Clean wound	Potential tetanus wound	Potential tetanus wound
	Vaccine (Td)	IGT	Td	IGT
<3 doses or unknown	YES (complete primary vaccination)	NO	YES (complete primary vaccination)	YES
3 or 4 doses	NO (if last dose more than 10 years ago, give 1 dose)	NO	NO (if last dose more than 5 years ago, give 1 dose)	NO
5 or more doses	NO	NO	NO (if last dose more than 10 years ago, consider giving an additional dose depending on the type of injury)	NO

Table 5. SERGAS tetanus vaccination recommendations

For immuno-suppressed and IV drug addicts, a dose of Immunoglobulin for potential tetanus wounds regardless of vaccination status.

Potentially tetanus-contaminated wounds with large amounts of material that may contain spores and/or have large areas of devitalised tissue will receive a dose of immunoglobulin.

Immunoglobulin dose

The injection should be given in a separate site from the vaccine, usually 250 IU. If more than 24 hours have passed and the weight is more than 90 kg, in wounds with high risk of contamination or burns, fractures or infected wounds, a dose of 500 IU will be administered.

For more information on tetanus vaccination Directorate of Public Health and Planning:
<https://www.sergas.gal/Saude-publica/Documento-calendario-adultos->

10 | DRESSINGS AND NURSING CARE

Acute injuries have an orderly repair process to restore the anatomical and functional integrity of the affected area.

The main goal of wound care is to create **optimal conditions** for their healing, allowing the **recovery of skin** integrity and preserving and restoring the function of the injured area, in addition to aesthetics. To do this, one must:

- Promote patient welfare.
- Correct factors that inhibit healing, thus decreasing healing time.
- Control the bleeding.
- Prevent complications:
 - Oedema.
 - Local infection (protecting the wound from bacterial contamination) and systemic infection.
 - Dehiscence.
 - Hypergranulation.
 - Evisceration.
 - Compartment syndrome.

10.1. CONSIDERATIONS

The needs of each wound and patient must be assessed individually, establishing an individual care plan in each case. At local level, there is no master formula that can be used for all types of injuries, the process must be adapted to the characteristics of each one, and the evolution must be assessed chronologically. Consideration will be given to:

- Patient-specific information (pathophysiology that may delay healing).
- Information and evolution of the condition of the skin and perilesional area.
- Wound information, as may be:
 - **Production mechanism:** establish the care according to the type of healing (primary intention, secondary intention and tertiary intention).
 - **Appearance** (bleeding, inflammation, redness, oedema): detecting complications early.
 - **Size** (width and length of the surface): classify its gravity (according to possible blood loss), its prognosis and control its evolution.
 - **Depth:** assess the affected structures.

- **Drain or exudate:** observe the location, colour, consistency, odour and degree of saturation of dressings for early detection of complications and to monitor their progress.
- **Oedema:** identify tension or tightness of the tissues.
- **Pain:** detect persistence of severe or sudden onset pain as a sign of alarm.
- **Drains or tubes:** check the safety and location of drains, the quantity and appearance and correct operation of the collection system (if any).
- Risk factors.
- Effective treatment.
- Potential consequences of the injury on the patient's condition.

10.2. CLEANING OF WOUNDS⁷⁸

Cleaning objectives

- Removal of foreign bodies.
- Prevent infection.
- Avoid affecting other surrounding tissues.
- Management of inflammatory exudate and facilitating drainage.

Procedure

- Inform the patient of the procedure to be performed.
- Place the patient in a comfortable position that is suitable for cleaning.
- Clean the wound and change the dressing daily if necessary.
- Use isotonic saline solution at 30°-35°C, as cold delays wound healing.
- It is recommended not to irrigate with uncontrolled pressure to avoid injuring the incipient granulation tissue.

In addition, we could assess that:

- Patient showering has no impact on the infection or wound healing rate, but it does have a wellness and health benefit associated with cleaning (**Degree of recommendation A**).
- Tap water for simple lacerations (**Degree of recommendation A**).
- 13 psi pressure cleaning that is effective in reducing both infection and inflammation in adults and children with traumatic lacerations or wounds, this pressure can be achieved with 20cc syringe + 0.8mm (21G) catheter (**Degree of recommendation B**).
- **Whirlpool therapy:** hydrotherapy with pressure irrigation, which mobilizes and removes necrotic tissue, remains of detritus and exudates, resulting in reduced wound inflammation and pain (Degree of Recommendation C).

Recommendations for the use of Antiseptic in the Wound

In order to avoid infection of the traumatic wound, the first step is to maintain good hand hygiene at all times in accordance with WHO recommendations.⁷⁹ The second step is the use of drinking water, physiological serum or double-distilled water at room temperature (not cold), used with a 20 cc syringe, which is equivalent to a pressure of 1-4 kg/cm² to clean the wound.⁸⁰⁻⁸⁴

As an exception, the primary objective for using antiseptics on a wound is the prevention of wound infection. We will use them for integrated skin or disinfection (after cleaning) the areas surrounding the lesion.⁸⁵

The most commonly used antiseptics are:^(51,86-92)

ANTISEPTIC	TYPE	ACTION	PERMANENCE	DISADVANTAGES	USE
Alcohol 70% (ethanol)	Bactericide	Immediate	No	Irritant and forms a clot that protects surviving bacteria	Integral skin, hand hygiene
Isopropyl alcohol 70%	Bactericide	Immediate	No	Irritant and forms a clot that protects surviving bacteria	Integral skin, (disinfection)
Oxygenated water at 3%	Bactericide	Immediate	No	Embolism risk	Cleaning of very dirty or suspected anaerobic wounds
Alcoholic chlorhexidine 2%	Sporos-tatoccus+ fungistatic bactericide	15-30 s	6 hours	Not for use in children, ENT, neurosurgery, ophthalmology	Integral skin
Aqueous Chlorhexidine 2%	Bactericide	15-30 s	6 hours	Not for use in children, ENT, neurosurgery, ophthalmology	Cleaning of wounds
0.5% aqueous chlorhexidine	Bactericide	15-30 s	6 hours	Not for use in neonates, ENT, neurosurgery, ophthalmology	Cleaning of wounds
Aqueous povidone-iodine 10%	Bactericide	3 minutes	3 hours	Not for use on newborns or pregnant women	Cleaning of wounds Skin disinfection
Povidone Iodine at 3%	Bactericide	3 minutes	3 hours	Not for use on newborns or pregnant women	Cleaning of wounds
Octenidine dihydrochloride 0.3%	Bactericide	30-120 s	24 hours	Do not use with iodine	Decontaminant for skin, mucous membranes and open wounds
Polyhexanide + betaine	Bactericide	3-20minutes	Very high	Should not be used in the CNS, meninges or middle ear	Colonised wound cleansing and biofilm

Table 6. Most frequently used antiseptics and their characteristics

10.3. CARE OF A WOUND THAT HEALS BY PRIMARY INTENTION

We are in a situation of:

- Normal healing process.
- Precisely and cleanly sutured tissue.
- Edges that are clean and close together.
- No contamination or minimal contamination.

The healing process is characterised by:

- Minimal oedema.
- No evidence of local infection.
- Scarce exudate.
- Minimal risk of separation of wound edges and low probability of scar formation.

The objectives are:

- To protect from bacterial contamination and foreign bodies.
- To manage exudate and perilesional skin care.
- To minimize oedema and decrease the dead space with a certain degree of compression.
- To prevent heat and fluid loss from the wound, create a warm occlusive environment.
- To assess and properly control pain.

Traditional Healing Procedure^{78,79}

Traditional healing, also known as “dry healing”, consists of cleaning the lesion with some antiseptic, and then covering it with a gauze dressing or leaving it in the air. This type of healing is usually done following a “clean” (aseptic), but not sterile, procedure which includes the following steps:

- Inform the patient of the procedure to be performed.
- Place the patient in a comfortable position that is suitable for cleaning.
- Clean the wound (daily) and change the dressing.

The materials normally used are:

- Cleaning materials.
- Antiseptics.
- Debriding agents.
- Topical antimicrobials.
- Cotton dressings (although not recommended because they can leave fibre residues in the lesion), gauze and textile dressings).

A limited use of traditional healing is recommended, related to the following reasons:

- It does not isolate the wound from external agents.
- It does not help to preserve the moisture level in the wound, which delays the healing process.
- Poor temperature management which causes cells to dehydrate and die.
- Crust formation that delays the formation of new tissue.

However, its use continues to be justified in some specific situations, as demonstrated by current clinical practice, in:⁷⁹

- Acute Wounds.
- Wounds closed by primary intention with suture or staples; however, it should be noted that there is sufficient evidence that the use of topical antiseptics is not necessary to reduce the risk of surgical site infection (they would only be recommended in the preoperative skin preparation phase); instead, the use of sterile saline for wound cleansing is recommended for the first 48 hours after surgery and normal showering is undertaken after those first 48 hours after surgery.^{93,94}
- Ischemic-type lesions where revascularization is not possible.
- Necrotic lesions.
- Wounds in which the objective is to prevent infection, since healing is not possible.

As an alternative to traditional healing, various products for curing in a humid environment are used more and more often (and with good results). One of the methods that shows the best results, in the case of surgical wounds, is the one known as the **Möln dal technique**, so its use could be considered for acute traumatic injuries.

Healing with the Möln dal Technique

As an alternative to traditional healing, we can opt for the use of hydrocolloid dressings to manage traumatic wounds that would initially heal by primary intention, but in which we want to minimize both the risks and possible complications.

The Möln dal technique is considered as a recommended clinical practice in surgical wounds due to:

- Avoiding complications in the healing process:
 - Infection of the lesion.
 - Formation of flichtena in the perilesional skin.
 - Maceration.
 - Dehiscence.
- Optimizing health resources:
 - Improving the cost-effectiveness of the dressings.
 - Decreasing healing time and nursing workload.

- Promoting patient comfort:
 - Reduced dressing changes (less discomfort and less consumption of products).
 - Allowing body hygiene without limitations derived from the surgical wound and early mobilization of the patient after surgery.

As with most traumatic wounds, the operating theatre is not required, a variant of this technique, the “**Modified Mölndal Technique**”⁹⁵ is proposed.

In the modified Mölndal technique, as in the original, a central area of hydrocolloid hydrofibre is used, which is covered with a polyurethane film dressing, but which would be applied by aseptic technique after closing and cleaning the wound (not sterile and in the operating theatre, as in the original technique).

The main objective of the technique, is to handle the lesion as little as possible, while ensuring the retention of possible leaks, (which, with other methods, would force the immediate change of the dressing) and physical and bacteriological protection of the wound, providing optimal conditions for healing.

This technique allows daily review and examination of the wound (visually and by soft palpation), without the need to lift the dressing, while also allowing to space out the frequency of the dressings up to a maximum period of 7 days from the completion of the closure.

A new dressing should be applied (clean the lesion and replace the dressing), if there are signs of infection, saturation of the hydrofibre or if the polyurethane film comes off.

This type of healing, improves the autonomy of the patient, since it allows his personal hygiene (he can take a shower) and does not interfere with his mobility.

The examination and review of the lesion, (without lifting the dressing), consists of:

- Checking the condition of the wound: leakage and inflammatory signs (flushing, heat, tumour and pain).
- Assessing with the patient the option of self-care and the scheduled follow-up every 72 hours with their primary care nurse. Any incident should be reported immediately for re-assessment.

In the case of wounds that have been sutured, the probable date for the removal of the suture material should be arranged, depending on the evolution. As a general rule, silk sutures will be removed on day 7-8 after suturing and the staples between days.⁸⁻¹⁰

ANATOMICAL AREA	DAY OF REMOVAL
Scalp	8-9
Neck and face	4-6
Chest, abdomen	7-12
Back	12-14
Limbs	8-12

Table 7. Estimated suture removal time according to anatomical area

Suture removal procedure:⁹⁶

An aseptic technique will be performed according to the following recommendations:

- Gently remove the dressing and carefully assess the wound.
- If the patient has a drain, this shall remain independent from the wound whenever possible.
- Clean the area with antiseptic (aqueous chlorhexidine 2%).
- Leave on for at least 1 minute and dry the area.
- **Separate stitches:** hold the stitch in place with tweezers, pull it out so that the thread underneath is visible, cut underneath the knot in the area closest to the skin, and gently remove it while holding the skin in place with the hand (this minimizes both discomfort and traction).
- **Continuous suture:** mobilize both ends of the suture, cutting one of them and gently pulling on the other. At the same time, hold the skin with the other hand until the entire suture thread comes out.
- **Staples:** use a staple remover, hook the staple in the centre, pressing it all the way down in one movement, so that it automatically comes out attached to the remover.
- Clean the area again with antiseptic and cover with a dressing (the patient should be advised to shower with total normality).^{36,37}
- Optionally, adhesive strips could be used to decrease the tension of the skin in the first days after the removal of the suture (about 5-7 days).
- It is advisable to avoid sun exposure for the next 6 months; the use of sunscreen is recommended in areas exposed to light to avoid changes in the colour of the skin in the scar.
- Moisturise the area on a regular basis to achieve a better aesthetic result, in addition to improving patient comfort (improves elasticity and reduces itching).

Management of traumatic wound complications

- **Control of Oedema:** In all cases where oedema are formed, treatment should be aimed at correcting the cause/disease that cause them.
- The general treatment measures are:
 - Bed rest with the affected limb being raised.
 - Low-salt diet.
 - Use of diuretic treatment to manage fluids if necessary and after medical assessment.
 - Elastic stockings to control oedema and improve venous return.
 - Protect the swollen area from pressure, lesions and extreme temperatures (lesions in oedema areas have a delayed healing process and are more likely to become infected).
 - In case of pain, irritation, redness or heat in the area, it should be assessed by the doctor responsible for the patient.
- **Prevention of Dehiscence:**^{97,98} the measures will be aimed at the early detection of symptoms that indicate that a total or partial opening of the wound may take place, 95% of dehiscences take place between days 4 and 14.

We must assess:

- Fluid leaking through the wound suture.
- Presence of signs of local infection.
- Slightly separated wound edges.
- Feeling of mass and pain.

It is important to make a good assessment of the risk factors that predispose to dehiscence, as well as the nutritional level.

- **Hypergranulation control:**^{31,99-101} hypergranulation is an excess of granulation tissue on the surface of a wound bed that complicates the normal healing process. It is frequent in those wounds where we are forced to let them heal by secondary intention, and it is usually related to an excessively inflammatory healing process.

Other factors that predispose to Hypergranulation and that we must take into account are:

- **Superinfection.**
- **Dermatitis:** irritative, allergic or contact.
- **Occlusion:** uso de apósitos tipo hidrocóide.
- **Friction.**

The treatment will, as always, be aimed at correcting the cause, but within our clinical practice it may be advisable to use:

- **Silver (Ag) dressings** in case of super-infection due to its anti-bacterial properties.

- **Polyurethane foam CAH:** for moisture management, to exercise a certain degree of pressure on the wound and decrease local oedema.
- Local compressive therapy (unless contraindicated due to previous pathology).
- Anti-oedema postural measures.
- **Topical corticosteroid:** response is usually good because of its anti-inflammatory effect. The treatment is applied for around 7 days, always under clinical assessment and supervision.
- **Silver nitrate bars:** is probably one of the most effective treatments for removing excess granulation tissue, especially in areas that do not respond to previous therapies. It is essential to limit its application to the affected area and it is highly recommended to protect the perilesional skin with an oily substance (Vaseline), to avoid chemical burns.

Care for a wound that heals by secondary intention

We are faced with:

- An open wound in which granulation tissue is developing, to encourage closure by itself.
- Infected wounds.
- Infected burns.

The healing process is characterised by being:

- Prolonged and complex.
- Presenting a high risk of infection.
- Significant tissue loss.
- Severe trauma or imprecise approach to wound edges.
- Risk of excessive growth of granulation tissue, which prevents correct epithelialization.

A certain compromise in the functionality of the repaired tissue may also result, as well as a poor aesthetic outcome.

Treatment alternatives

1. Traditional healing by secondary intention

As already mentioned in the section on healing by primary intention, there is still a relatively frequent use of certain products that can be applied topically; but although they still have some space in practice by some professionals, they are healing products and/or antibiotics that are not considered first choice, and whose functions and properties have taken over by new therapies and products that present greater effectiveness and less risk.

Although not recommended as a first choice, we should cite:

- Antiseptic Solutions and Ointments (Betadine ointment®).
- Antibiotic creams and ointments (Furacin®).

- Silver sulfadiazine creams (Silvederma®).
- Various vaseline and/or antibiotic-impregnated meshes (Tulgrasun® Linitul®).

For the use of this type of product, it is advisable to assess it daily and strictly follow the guidelines for dressings indicated in its technical data sheets (dressings every 12h or even every 8h) since in many cases they are responsible for the development of antibiotic resistance (which can be crossed), local reactions and/or allergies.

We currently have products that provide greater advantages (with greater antimicrobial power without generating resistance, greater effectiveness, more comfort in use for patients and professionals and fewer counter-productive effects, allowing us to better manage dressings (products and dressings with silver and other anti-biofilm substances, iodized cadexomer, products based on polyhexanide (PHBM), etc.).

2. Moist healing environment dressings (MHE)

- They form a protective barrier against contamination and external agents.
- They maintain the optimal temperature and humidity level in the lesion bed.
- They improve the supply of oxygen and nutrients through the angiogenesis they promote.
- They acidify the pH of the area creating a bacteriostatic environment that decreases the risk of infection.
- They facilitate cell migration.
- They control the exudate without damaging the periulcer skin.
- They reduce healing times.
- They control and/or reduce pain.
- They allow for a simpler, more comfortable and more time-spaced type of dressing.

As an example, the use of:

- **Meshes:** they are composed of a micro-adherent mesh that prevents the adherence of the dressing to the wound bed; they can be made of lipid-colloidal material, gauze, non-woven fabric, or silicone; incorporating in turn, substances such as silver sulfadiazine or silver in various presentations.
- **Fibres:** within the fibres we have Alginates, Hydrocolloids, Polyacrylates and Polyvinyl alcohol.

Fibres allow high levels of exudate to be managed, some of them even under a certain degree of pressure. In addition, they favour autolytic debridement, improving the healing process and the comfort of the patients (some also have a haemostatic effect, which can be interesting in case of risk of local bleeding).

In those situations where there is infection or colonization, the use of fibres with silver can be assessed (it should be re-assessed after 15 days).

We must bear in mind that, if they are to be used to treat cavities or fistulas, we must never fill the cavity beyond 75% of its volume.

- **Foams:** we have adhesive Polyurethane Foams and Polyurethane Foams with low adherence silicone, with different shapes, sizes and absorption capacity.

We must use those that are best suited, by their characteristics, to the type and characteristics of the lesion we are treating.

They allow high absorption of exudate and can be used both as a primary and secondary dressing. The adhesives should stick out between 1 and 2 cm from the edges of the lesion, always on intact skin.

- **Hydrocolloids:** they promote both debridement and the healing process. They improve patient comfort. They allow a certain degree of absorption of the exudate. They cannot be applied directly to bone structures, muscle or tendons, nor to infected wounds (nor in syphilis, fungal colonization or tuberculosis).

When putting them in place, it is important that they stick out between 1 and 3 cm from the edge of the lesion, always on intact skin. When putting them in place, it is important to apply local heat directly with the hands for 1 minute to improve their adhesiveness. They may be kept on for up to 7 days or until saturated with exudate (they can also be used in combination with fibre dressings).

For more information - See the CAH dressing combination protocol on the Fora Ulceras website: <https://ulcerasfora.sergas.gal/Recursos?idcat=13507>

Negative pressure therapy (NPT)^{102,103}

Negative pressure therapy consists of applying controlled sub-atmospheric pressure on the wound, as a non-invasive topical treatment, to promote and speed up the healing process. A negative pressure generator is used, which is placed as a supplement to special dressings that cover and fill the wound space (thus ensuring that the pressure is distributed evenly).

The usual pressure that negative pressure therapy works with is – **125 mmHg**.

The minimum negative pressure that can be applied to the wound is – **20 mmHg**.

In wounds without risk of ischemia, the combination of pressures provides the following benefits:

- In the high pressure range, it improves blood flow which, in turn, increases O₂ supply.
- In the low pressure range it stimulates angiogenesis favouring the formation of granulation tissue.

The main disadvantage is the pain it can cause due to repeated contraction.

Other pressures that we could assess, taking into account benefits-risks for both the patient and the type of injury, would be:

- **Pressure – 80 mmHg**
 - Maximum biological effect.
 - Contraction of the wound.
 - Formation of viable granulation tissue.
 - Removing large amounts of exudate.

- **Pressure – 40 mmHg**

- Patients with pain or poorly vascularized tissue (diabetic foot ulcers, skin grafts...)
- Risk is reduced and the benefits of NPT are maintained.

Its mechanism of action has the following characteristics:

- Healing in a moist environment.
- Evacuation of the exudate.
- Reduction of tissue oedema.
- Contraction of the wound edges.
- Mechanical stimulation of the wound bed.
- Increased blood flow at the edge of the wound.
- Stimulation of angiogenesis and the formation of granulation tissue.
- Reduced risk of contamination.

Short term objectives

- Pain control, odour and exudate.
- Cleaning the wound bed and removing sloughing.

Long-term objectives

- Reduction of the size of the lesion.
- Production of healthy granulation tissue.
- Closing the wound by healing with secondary intention.
- Functional restoration of the affected area.

Benefits

- Exudate control.
- Reduction in the number of dressing changes.
- Reduced risk of infection.
- Rapid granulation, epithelialization and contraction of the wound.
- Reduction of pain.
- Reduced wound odour.
- Cost reduction.
- Possibility of concurrent rehabilitation.

Care for a wound that heals by tertiary intention (deferred closure or late primary)

We are faced with:

- Contaminated, infected and dirty traumatic wounds.
- Wounds with great tissue loss.
- Large open wounds.
- Wounds with a high risk of infection.

The healing process is characterised by:

- Combining the two previous healing processes.
- Keeping the wound open for a minimum of 3-5 days.
- Wound closure is appropriate when clean granulation tissue is observed.
- Risk of contraction of the wounds that can cause important deformities (avoid).

11 NURSING CARE IN THE MANAGEMENT OF SKIN LACERATIONS AND DISSECTING HaematomaS SECONDARY TO DERMATOPOROSIS. PECULIARITIES

General care in patients with Dermatoporosis:^{36,37}

- Photoprotection.
- Hydration (retinoids, vitamins C-E, emollients, hyaluronic acid).
- Preventing trauma.
- In stages I, II and III: Hot compresses with paraffin to remove scab-necrosis.
- Apply emollients (lanolin, zinc oxide and hyaluronic acid).
- Cover with alginates / gauze according to the level of exudate.
- Support bandage / Compressive therapy (if oedema on lower limbs).
- Local treatment of lesions will be administered according to the characteristics and circumstances of each wound (**Figure 16**), following the general recommendations established for other types of wounds: If there is no destruction of the skin layers, the treatment should be conservative, applying moisturising and protective solutions.
- If there is continued deterioration of skin integrity, the guidelines for other traumatic injuries should be followed.



Figure 16. Dermatoporosis Action in Skin Tears - Lacerations. (Image source: Palomar Llatas F et al.^{36,37})

Skin lacerations

In the case of skin tears, we must follow a series of indications as indicated in **Figure 17** (assess, clean, approximate edges...)

It is very important, if the flap remains in the lesion (if it has not been removed), to indicate the direction in which the dressing should be removed, by means of an arrow drawn on the dressing itself (**Figure 18**) otherwise it is likely the flap will be removed when the dressing is changed.

In this type of injury it is quite common that the flap that has been detached with the trauma does not progress and becomes necrotic; therefore, it will be necessary to proceed with its debridement and continue the treatment of this injury following the criteria of closure by secondary intention.

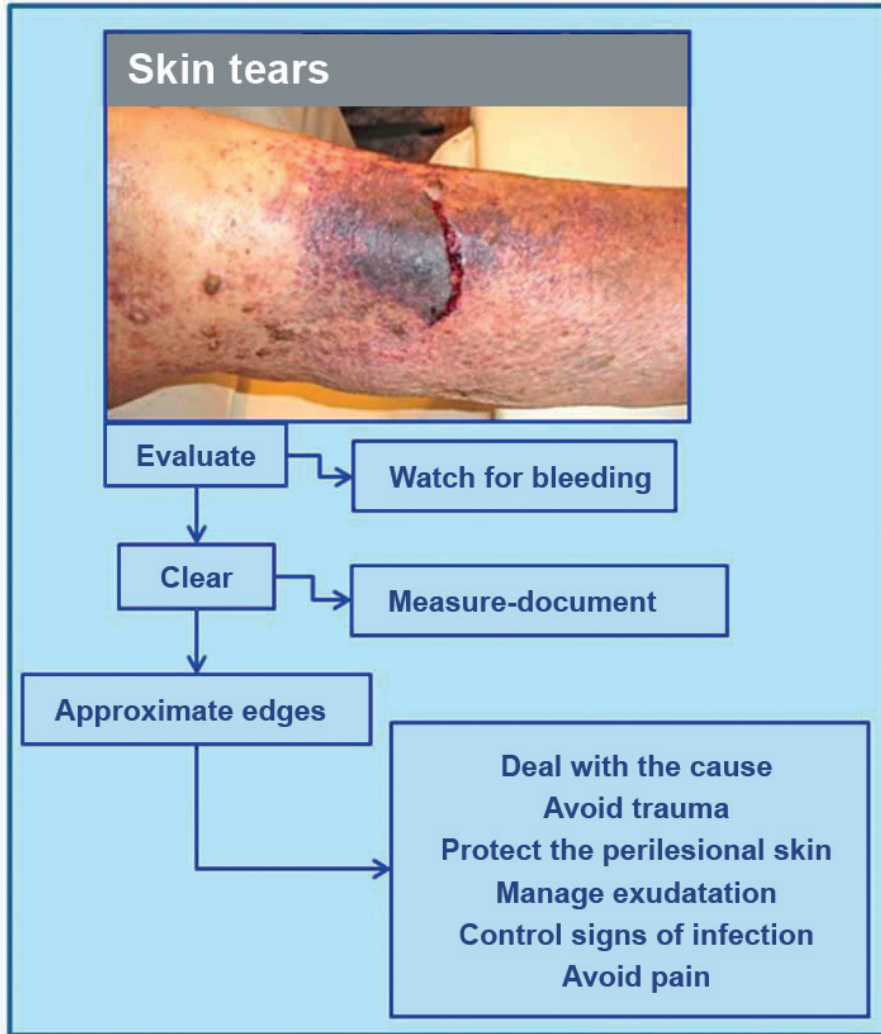


Figure 17. Dermatorporosis. Performance in Skin Tears - Lacerations. (Image source: Palomar Llatas F et al.³⁶)



Figure 18. Skin Tears. We must indicate the direction of dressing removal (Image source: Palomar Llatas F et al.^{36,37})

Dissecting haematoma

In the case of dissecting haematoma, it must be taken into account that the haematoma itself may be compressing healthy tissues, giving rise to a compartment syndrome, compromising the viability of adjacent tissues or even the affected limb if the increased pressure produces a vascular or nerve injury.

In these cases, the treatment consists of debridement of the haematoma (usually in a hospital setting) and then attempting closure by secondary intention.



Figure 19. Dermatoporosis Performance in Dissecting Haematoma (Image source: Palomar Llatas F et al.³⁶)

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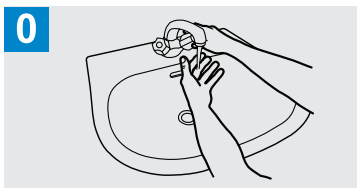
13 ANNEXES

Hand washing technique with soap and water



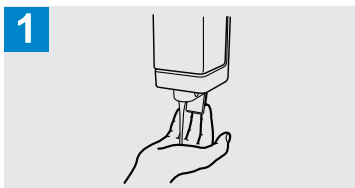
Procedure duration: 40-60 seconds

0



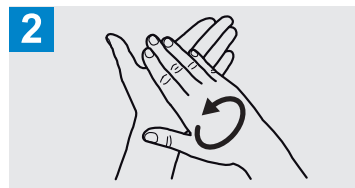
Wet your hands with water.

1



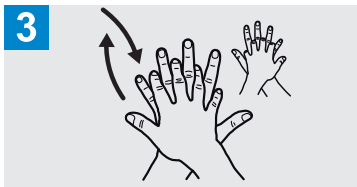
Put enough soap in the palm of the hand to cover all surfaces of the hands.

2



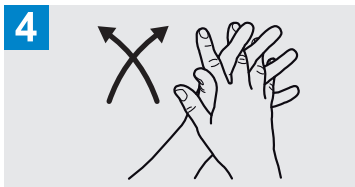
Rub the palms of your hands together.

3



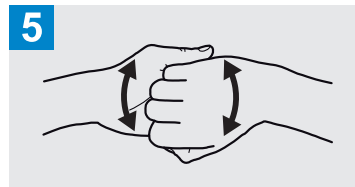
Rub the palm of your right hand against the back of your left hand interlocking your fingers and vice versa.

4



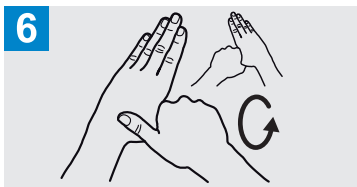
Rub your palms together, fingers intertwined.

5



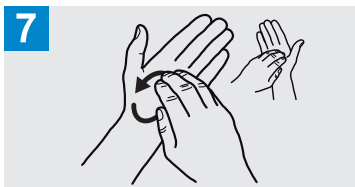
Rub the backs of the fingers of one hand with the palm of the opposite hand, grasping the fingers.

6



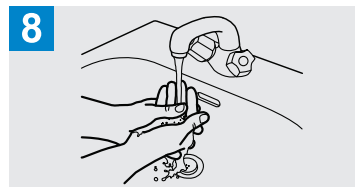
Rub your left thumb in a rotational motion, catching it with the palm of your right hand and vice versa.

7



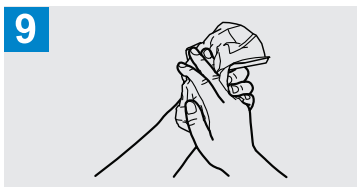
Rub the fingertips of the right hand against the palm of the left hand, making a rotational movement and vice versa.

8



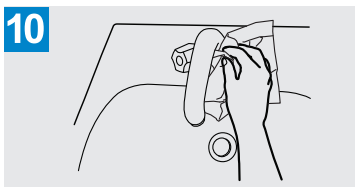
Rinse your hands with water.

9



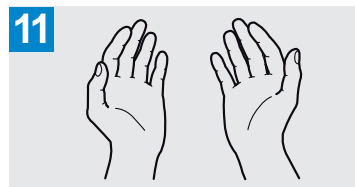
Take off with a disposable towel.

10



Use the towel to turn off the tap.

11



Your hands are ready.

Adapted from NHS and World Health Organization *Guidelines on Hand Hygiene in Health Care*

Hand hygiene technique with alcoholic preparations



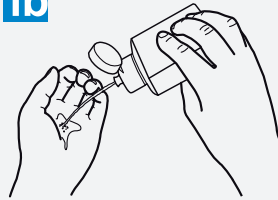
Procedure duration: 20-30 seconds

1a

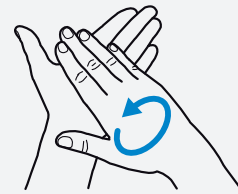


Place a sufficient dose of product in the palm of your hand to cover the entire surface.

1b

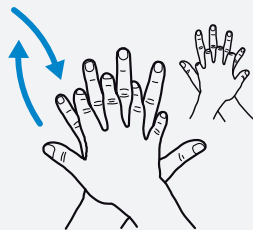


2



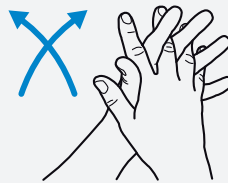
Rub the palms of your hands together.

3



Rub the palm of your right hand against the back of your left hand interlocking your fingers and vice versa.

4



Rub the palms of your hands together, with your fingers intertwined.

5



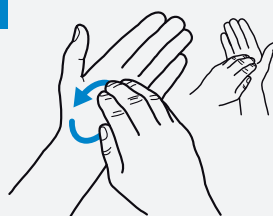
Rub the back of the fingers of one hand with the palm of the opposite hand, grasping your fingers.

6



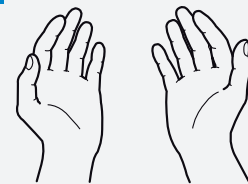
Rub the left thumb in a rotational motion, catching it with the palm of the right hand and vice versa.

7



Rub the fingertips of the right hand against the palm of the left hand, making a rotational motion and vice versa.

8



Once dry, your hands are ready.

Adapted from NHS and World Health Organization *Guidelines on Hand Hygiene in Health Care*

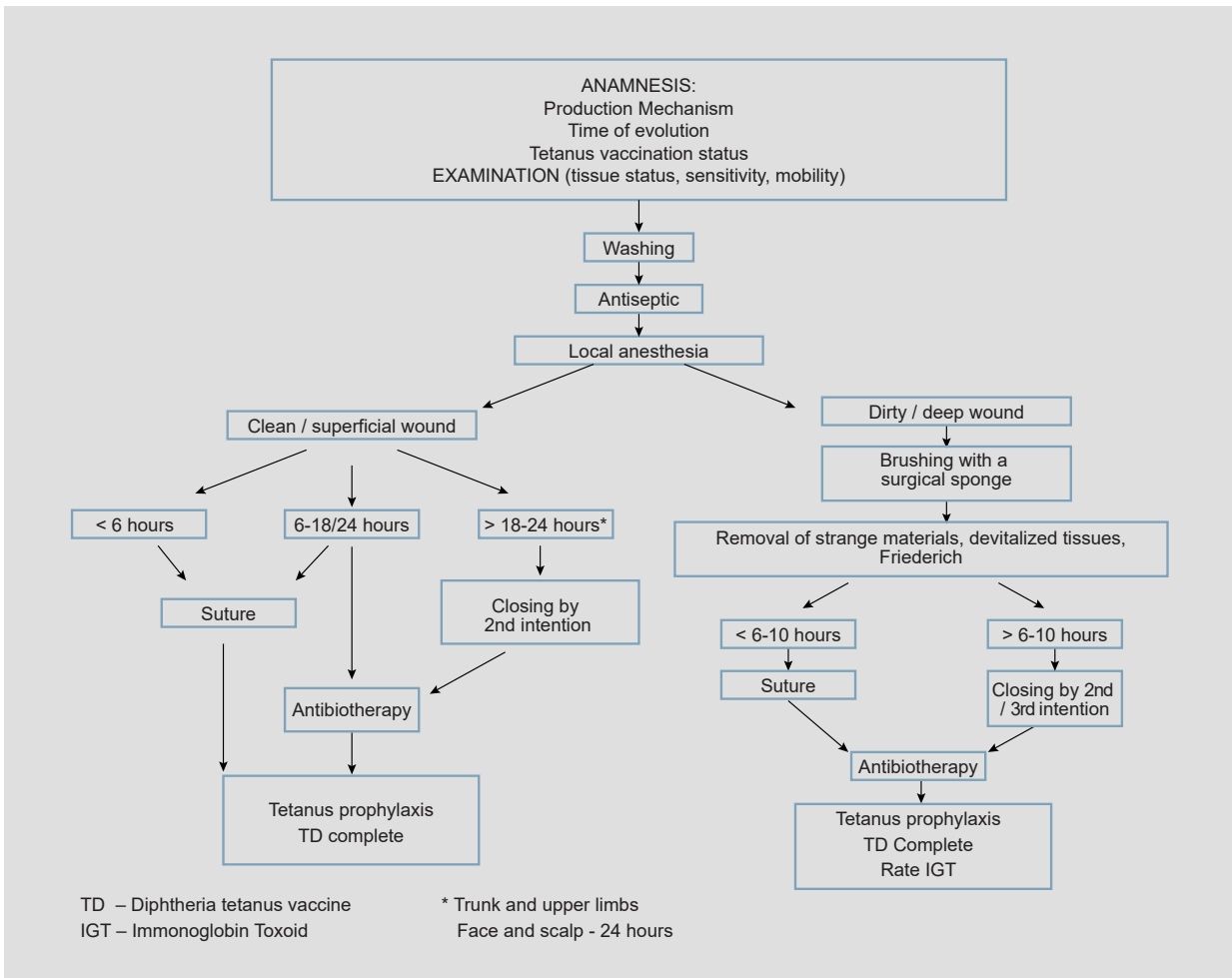
Self-care information sheet for the patient with traumatic injuries

SELF-CARE OF TRAUMATIC INJURIES	
MEDICATION (follow the instructions we have recommended)	<ul style="list-style-type: none"> – If you have been prescribed an antibiotic, take it when and for as long as it has been prescribed. – If you have pain after the anaesthesia wears off, you can take pain relief.
GENERAL CARE	<ul style="list-style-type: none"> – If the injury was to the head, maintain relative rest, with the head raised using a few pillows while resting. Try to be in a room with a cool temperature. – If the injury was to the arms/hands or legs/feet, for the first few days keep the affected limb raised and move the fingers as much as possible.
CARE OF THE DRESSING	<ul style="list-style-type: none"> – Depending on the type of dressing used it will need to be removed at a different time. Your the nurse will tell you when the next dressing is due. – Most wounds do not require a dressing after a few days, but you may choose to wear one to protect the healing wound. – If your wound is exposed to air, apply antiseptic as directed and try to keep the area clean.
BATHING	<ul style="list-style-type: none"> – Keep your wound clean and dry for the first 24 - 48 hours. Avoid prolonged showering or taking baths during this period. – After this time you can use soap and water to wash yourself, still avoiding baths and trying to keep showers short. – Gently dry the wound after washing and apply an antiseptic.
HAEMORRHAGE	<ul style="list-style-type: none"> – Most haemorrhages can be stopped by pressing on the wound for a few minutes. – If your dressing appears to be stained with blood, replace it with dry gauze, and if after pressing on the wound for a while it continues to bleed, go to your health centre.
INFECTION	<ul style="list-style-type: none"> – If you notice the presence of pus, fever, chills, or if the area is very painful, consult your health centre. – The edges of a healing wound may appear slightly red, which is normal. But if the redness increases or extends beyond the edge significantly, you should check this out.

REMOVAL OF SUTURES	<ul style="list-style-type: none"> – If you have required deep stitches, do not worry, as they will be absorbed by your body and do not need to be removed. – The stitches on your skin, depending on where they are and how quickly your incision heals, should in most cases be removed within 4 to 21 days (Your nurse will tell you when it is time to remove them). Sometimes, your nurse may put on some adhesive stitches after removing the stitches from the wound. Follow their instructions. – There is a type of suture, which is sometimes used on the skin and which is also reabsorbed, if this is the case, we would also inform you that it is not necessary to remove the stitches on the skin. – The healing skin may need several months to regain its original strength.
SCAR TENSION	<ul style="list-style-type: none"> – Injuries may have more or less tension depending on the location of the wound. Sometimes a splint will be placed on them to prevent mobilization of a joint so that the wound does not open. – Activities that may cause your scar to reopen must be avoided. Contact your nurse if the scar opens up.
SUN EXPOSURE	<ul style="list-style-type: none"> – A wound, when in the process of healing, should not be exposed to the sun continuously, (it may darken so that it will be more conspicuous and leave marks). – Limit your sun exposure for 6 months after the intervention/accident. Cover scar areas – After healing, it is advisable to use cream with a high sun protection factor.

GOOD PRACTICE RECOMMENDATIONS	EVIDENCE LEVEL
Hand washing with chlorhexidine (if visibly dirty). ⁶⁶	1-A
Hand washing with povidone-iodine soap. ⁶⁶	2-B
Surgical washing before any invasive procedure. ⁶⁶	1-A
Glove use does not replace the need for hand washing. ⁶⁶	1-B
Adequate wound cleaning is essential to avoid or stop contamination and subsequent infection. Cleaning and debridement should be as extensive and complete as possible, removing necrotic tissue, detritus, foreign bodies (soil, grass or any other highly contaminated material). The wounds must be examined and cleaned as often as necessary . ⁶⁶	1-B
The dissemination of the antibiotic within the haematoma and the necrotic or devitalized tissue is very bad. If there is antibiotic in the serum while the haematoma is developing or during the removal or debridement, the chance of further infection is less. It is one of the fundamental bases for early and aggressive debridement : remove all foreign bodies, devitalised or necrotic tissue. ⁶⁶	1-B
If the wounds are very dirty or have a lot of devitalised tissue, it is preferable to leave them open for a period of time after surgical cleaning, in order to assess their evolution and the need for further debridement. ⁶⁶	1-C
Antibiotic prophylaxis must be administered as soon as possible after the trauma or within 30 to 60 minutes of a surgical procedure (debridement of wounds, cleaning, reduction of exposed fractures...) during anaesthetic induction One dose is enough. Do not extend the antibiotic beyond this single dose, except when strongly indicated. ⁶⁶	1-A
Warming up local anaesthetics at 34° - 37° to reduce the pain of infiltration. ⁵⁷	2-B
The antibiotic should be administered intravenously at the maximum dose (at the highest recommended dose) respecting the recommended administration intervals. ⁶⁶	1-B
Soft tissue injury to the face without fracture: there is weak evidence for antibiotic prophylaxis . ⁶⁶	2-D
Patient showering has no impact on the infection or the rate of healing of wounds, but it is a benefit for the sense of well-being and health associated with cleaning. ⁷⁴	A

Use tap water for cleaning simple lacerations. ⁷⁴	A
13 psi pressure cleaning which is effective in reducing both infection and inflammation in adults and children with lacerations or traumatic wounds, this pressure can be achieved with a 20ml syringe + 0.8mm (21G) catheter. ⁷⁴	B
Whirlpool therapy: hydrotherapy with pressure irrigation , which mobilizes and eliminates necrotic tissue, detritus and exudates, which reduces inflammation of the wound and pain. ⁷⁴	C





XUNTA
DE GALICIA

CONSELLERÍA DE
SANIDADE

