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SYSTEMATIC REVIEW

Surgical treatment of burned hand: differences between adult and pediatric patients

Tratamiento quirúrgico de mano quemada: diferencias entre pacientes adultos y pediátricos

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ABSTRACT

Introduction: the hand is very susceptible to burn injuries, affecting the vast majority of burn patients and impairing their functionality and quality of life. More than 50 % of those affected are pediatric, which makes recovery difficult because their tissues are in full growth.
Objective: to determine the best treatment to recover the functionality of the burned hand, and minimize the consequences of contractures.
Method: an exhaustive search was carried out where relevant works were selected for this study, for their treatment and reconstruction techniques, and the age of their patients. The variable of greatest consideration is the functionality of the hand.
Results: in the case of pediatric hands, which have a greater propensity for poor healing, it is essential to evaluate the procedures and their reconstructive results in the acute phase to reduce surgeries due to complications. Patients are more concerned about their aesthetic appearance, especially children, and about their functionality, despite the pain they may feel.
Conclusions: surgical treatment, performed by a team of specialists, is the best option to prevent and resolve scars and contractures that hinder hand functionality, as well as aesthetics and growth sequelae in pediatric patients.

Keywords: Hand Burn; Burn Excision; Contracture; Scar; Pediatric Burn Injury.

RESUMEN

Introducción: la mano es muy susceptible a las lesiones por quemaduras, afectando a la gran mayoría de los pacientes quemados, y perjudicándolos en su funcionalidad y calidad de vida. Más del 50 % de los afectados son pediátricos, lo que dificulta la recuperación porque sus tejidos están en pleno crecimiento.
Objetivo: determinar el mejor tratamiento para recuperar la funcionalidad de la mano quemada, y minimizar las secuelas por contracturas.
Método: se realizó una búsqueda exhaustiva donde se seleccionaron trabajos relevantes para este estudio, por sus técnicas de tratamiento, reconstrucción, y la edad de sus pacientes. La variable de mayor consideración es la funcionalidad de la mano.
Resultados: en el caso de manos pediátricas, que tienen una mayor propensión a la mala cicatrización, es primordial evaluar los procedimientos y sus resultados reconstructivos en la fase aguda para disminuir las cirugías por complicaciones. Los pacientes se preocupan más por su apariencia estética, en especial los niños, y por su funcionalidad, a pesar del dolor que puedan sentir.
Conclusiones: el tratamiento quirúrgico, realizado por un equipo de especialistas, es la mejor opción para prevenir y resolver cicatrices y contracturas que dificulten la funcionalidad de la mano, como también la estética y las secuelas de crecimiento en los pacientes pediátricos.

Palabras clave: Quemadura de Mano; Escisión por Quemadura; Contractura; Cicatriz; Injuria por Quemaduras Pediátricas.

INTRODUCTION

Burns are the most important cause of disability mor, morbidity, and mortality in the world.[1] Burns constitute one of the most significant health problems since they can affect various systems. Therefore, it is necessary to have adequate and multidisciplinary management according to the needs of each type of patient to avoid irreversible alterations.[2]

The skin is the most significant barrier that serves as a defense against the environment of different stressors.[3] the hand is one of the three most prevalent sites of contracture deformity and burn scarring; its functionality is a crucial predictor of the quality of life of burn survivors. The hands account for 3 % to 5 % of the body surface area, although in burn patients, they represent more than 80 % of the severely affected areas and may compromise their function in the long term. This makes them particularly incapacitating due to the loss of sensory and gripping capacity, making it impossible for the patient to manipulate objects of daily use and necessity.[1]

The skin harbors a complex community of microorganisms that are crucial to its health and disease. Understanding how treatments affect this microbiota is vital to developing effective and safe therapies.[4] The skin and soft tissues of the hand possess unique anatomical and histological properties: the dorsal skin is thin and flexible, supported by a thin subcutaneous layer of adipose tissue. This structure provides little mechanical protection but allows maximum tendon excursion and joint mobility without the need for excess skin. The skin is fragile over the proximal interphalangeal joints, where the extensor tendons are at risk.[2]

The medial palmar aponeurosis, together with the tenar and hypothenar aponeuroses, the fibrous complex of the first commissure, the ligamentum natatorum with its components, and the paratendinous skin system, make up the retinaculum of the hand. Its functions are the retention of the skin, the formation of its folds and the interdigital commissures, and to delimit compartments where vessels, nerves, muscles, and tendons are housed.[3]

The appearance of the hands is significant to all burn patients and is an integral part of human interactions, social integration, and communication.[4] Hands are visible both to oneself and to the public.[5] Therefore, patients are concerned about the appearance of their hands even when faced with a disabling ailment.[6] Hand trauma specialists working with burn plastic surgeons focus primarily on functional outcomes.[7]

The pediatric hand develops rapidly during the first year of life. Between 5 and 6 months, the instinctive palmar grasp develops. Up to this time, the hands are marked by fine scars, but older children show a propensity for hypertrophy, inflammation, and contracture. This propensity characterizes the immediate post-burn course, impairing reconstructive outcomes. Significant complications include hand balance distortion, inability to develop normally, and limb length discrepancy.[7]

Contracture, as a complication associated with burns, very frequently leads patients to consult a hand trauma specialist for treatment. The optimal treatment method should always consider timely consultation with surgeons for the excision of scar tissue.

Medicine has evolved significantly over time, thanks to the contributions of numerous researchers whose studies and discoveries have driven the progress of its various branches.[8] Properly planned and well-executed reconstructive interventions can help promote significant functional recovery. This will be demonstrated in the following paragraphs, analyzing different surgical techniques for treating and reconstructing scars, the advantages of some surgeries over others, and the resolution of sequelae in search of the desired results.[9]

Therefore, this article aims to determine the best treatment to recover the burned hand's functionality and minimize the sequelae due to contractures.

METHOD

Based on a systematic review of the most relevant articles published in the last 15 years from research in countries with high burn rates, an observational, descriptive, and cross-sectional analysis was carried out in a university setting at the UAI School of Medicine to study a population of patients of both sexes with burns affecting their hands in the last ten years, and with the following criteria:

Inclusion criteria

- Scientific papers in English, Spanish and German.
- Patients with AB-B burns.
- Patients with hand burns.
- Patients older than 6 months and younger than 41 years.

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- Burns produced in the 10 years prior to the prior to the attempted reconstruction of sequelae.
- Patients studied between 2008 and 2023.

Exclusion criteria

- Patients who have suffered hand amputation.
- Chemical burns.
- Patients with previous diseases or diseases developed after the burn that may interfere with treatment and recovery.
- Patients who do not continue follow-up in the treating hospital.

A consistently high proportion of childhood thermal injuries affect the hands of infants and young children, with scalds and contact burns being the most common[10] in contrast to adults, which include direct fire. Regardless of the surgical procedure, the rate of scar contractures following thermal hand injuries in children is very high.[11] Due to rapid growth, these scars develop more rapidly in children's hands than in adults.[12]

RESULTS

Figure 1 shows a predominance of male sex with 56,83 % and age between 1 and 4 years with 51,07 %.

Grupo de edades (años)	Sexo				Total	
	Masculino		Femenino			
	No	%	No	%	No	%
Menores de 1	15	10,79	13	9,35	28	20,14
1-4	43	30,93	28	20,14	71	51,07
5-9	10	7,19	12	8,63	22	15,82
10-14	10	7,19	6	4,31	16	11,51
Mayores de 15	1	0,71	1	0,71	2	1,42
Total	79	56,83	60	43,16	139	100

Figure 1. Distribution of 139 patients according to age and sex.[13]

Contractures of the hand have been a common complication of burns, resulting in disability.[14] The goal of surgical treatment is to obliterate the contracture, restoring hand function without scar tissue recurrence.

Proper treatment in the acute phase of the thermal injury is of utmost importance because it dictates, to a large extent, the outcome. Loss of hand function is often caused by scar contractures, significantly impacting quality of life. Eighty percent of patients require reconstructive surgery with a hand specialist during the follow-up period, which is necessary to improve function.[15]

Contractures are caused by the spontaneous healing of deeper burns or by the healing of transplanted partial-thickness skin grafts.[16]

Z-plastics can achieve the release of contractures but often require skin grafting or flap coverage.[17] Full-thickness skin grafts play an essential role in these secondary corrections because they are more similar to normal skin in texture, color, and strength than partial-thickness grafts[18] and show less tendency to secondary contractures.[19] However, full-thickness grafts are less quickly taken than partial-thickness grafts and are sometimes hampered by limited availability in extensive burns, even using expanders at the donor sites.[17]

In the case of the thumb, contractures of the first interdigital space have resulted from hypertrophic scarring or skin shortage and contraction of the adductor muscle, fascia, and joint capsule. [18] This restricts movement, and surgery is intended to restore its functionality so that the patient can use the pincer movement and thus be able to perform the activities considered central for a person, according to the DASH scoring criteria: grasping cutlery, moving objects, writing, opening a can, and combing one's hair.

Flexion contractures of the post-burn fingers functionally impair them and restrict the functional capacity of the whole hand.

Dorsal dermal contracture is the most common, with lesions limited to the skin without affecting tendons and other structures. Limitation of finger flexion usually occurs after skin grafting and may result from insufficient skin coverage, partial graft loss, wound infection, or inadequate splinting.[20]

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Figure 2. Postoperative result of a hand in severe abduction contracture: A) severe contracture in thumb abduction in pediatric patients. B) release of contracture and abductor muscles, resulting in deep space requiring flap reconstruction. C) immediate postoperative result, D) postoperative result at four weeks with a perfectly healed flap.[19]

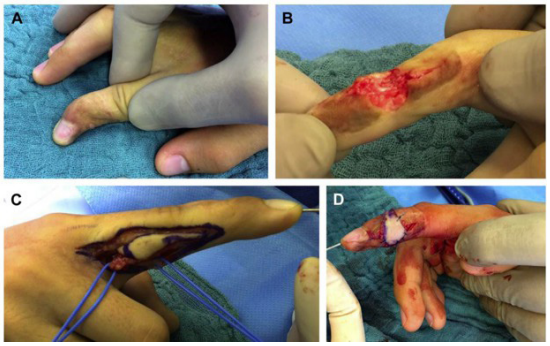

Figure 3. Flexion contracture of the fingers after burns: A) Flexion/adduction contracture of the right index finger. B) post joint and soft tissue release status. C) elevation of reverse homodigital flap. D) the flap was rotated, and the released area was covered.[20]

Figure 4. Exposed joint after partial skin graft rupture: A) exposed joint after partial skin graft rupture. B) elevated flap from the dorsum of the hand. C) immediate postoperative result.[21]

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The reconstruction was aimed at improving the function and esthetics of the hand. The surgical team had to be accurate in assessing the condition, including which tissues were inadequate and which were available for reconstruction.[20]

Satisfacción	norte	% del total de nitrógeno
Completa satisfacción	6	40,0%
Satisfacción	8	53,3%
sin tener opinion	1	6,7%
Sin satisfacción	0	0%
Total	15	100,0%

Figure 5. Postoperative patient satisfaction score[19]

Correction of the burn damage consisted of complete excision of the contracted tissues and mobilization of all adjacent joints. Full-thickness skin grafts were the primary option for reconstruction. Restoration of the dorsum of a hand with full-thickness skin grafts required a considerable amount of skin that was not always available. Therefore, thick, partial-thickness skin grafts have been a reasonable alternative.

Flaps were considered whenever there was doubt about the wound bed and graft acceptance rate.[20] Fascial flaps have proven excellent because they provide a thin, stable, flexible coverage that requires only a partial-thickness skin graft.[21]

Of the total number of patients studied, in almost all age ranges, the predominance of victims has been male, with the segment from 1 to 4 years being the most affected, with 51,07 % of the cases due to hot liquids and direct contact.

DISCUSSION

The main objective of trying to recover the functionality of the hand that has suffered a burn is to allow the patient to recover the ability to perform the main daily activities. In the case of pediatric hands, which have a greater propensity for poor healing, it is paramount to evaluate procedures and their reconstructive outcomes in the acute phase to decrease surgeries for complications.

Patients are more concerned about their aesthetic appearance, especially children, and their functionality, despite the pain they may feel. In children under six, scars form faster, so early debridement and timely planning of coverage surgery is essential to prevent future contractures. Unfortunately, to date, 80 % of patients require reconstruction surgery, and unlike adults, in children, many specialists choose to wait a few years, which affects the social development of the individual.

It is essential to highlight the Z-plasty technique for scar release versus the benefits of a skin graft or flap. Specialists should evaluate this to prevent complications and contracture recurrences. The field presents promising future directions, but more research is needed, particularly regarding new treatments, understanding local relapse, and improving postoperative quality of life.[22]

CONCLUSIONS

If timely, planned, and well executed, interventions promote significant recovery in time and function. Surgical treatment, performed by a team of specialists, is the best option to prevent and resolve scars and contractures that hinder the hand's functionality and esthetic and growth sequelae in pediatric patients.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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