BREAST BURNS SCAR RECONSTRUCTION: A SYSTEMATIC REVIEW OF MANAGEMENT CONSIDERATIONS AND RECOMMENDATIONS

RECONSTRUCTION MAMMAIRE APRÈS BRÛLURE : REVUE DE LA LITTÉRATURE ET RECOMMANDATIONS

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SUMMARY. Breast burns scar reconstruction presents a unique challenge to the plastic surgeon. The consensus view and evidence base for the optimum reconstructive approach to take is not yet established in the literature. This study aims to review the literature to ascertain evidence-based principles for management of this patient cohort. A literature search of Medline was performed using the mesh terms: "breast burns", "chest burns", "reconstruction" and "surgery". Screening was performed by two independent assessors, with a senior assessor to resolve discrepancies. Expert articles, reviews, individual case reports and letters were excluded. Literature search generated 1,385 publications. Of these, 22 were deemed eligible for inclusion in this review. These encompassed 483 patients. We present the operative considerations, surgical technique used and outcomes. The recommendations from included literature were summarised to guide the surgeon when approaching breast burns. These include tangential excision, breast bud preservation, scar release at onset of thelarche, and reconstruction only once breast development has completed. Reconstructive approaches and their indications vary with burn severity, status of abdominal and back tissue, and unilateral or bilateral burn injury. The literature on breast burns reconstruction defines certain key steps for management. There is limited quantitative data on the various reconstructive options and lack of long term follow up data. Further work is needed to establish if a particular surgical approach leads to superior results when compared with others.

Keywords: breast burns, chest burns, burn reconstruction, breast reconstruction

RÉSUMÉ. *La reconstruction mammaire après brûlure est un défi pour le chirurgien plasticien. La littérature ne fait pas état de consensus concernant la stratégie optimale. Nous avons conduit une revue de la littérature, dans le but de dégager des principes stratégiques basés sur les faits. Les termes utilisés pour la recherche Medline étaient : « breast burns », « chest burns », « reconstruction » et « surgery ». La recherche était réalisée par 2 experts indépendants, un 3ème étant chargé de résoudre les divergences d'opinion. Les avis d'experts, revues, cas isolés et lettres aux rédacteurs n'ont pas étés retenus. Nous avons retenu 22 des 1 385 articles évalués, regroupant 483 patientes. Nous présentons les considérations opératoires, la technique utilisée et les résultats. Nous en avons tiré des recommandations destinées à aider les chirurgiens dans leur prise en charge des brûlures thoraciques. Elles incluent l'excision tangentielle, la préservation aréolaire, la libération cicatricielle dès le début de la puberté et la reconstruction seulement après la fin du développement mammaire. La stratégie dépend de la gravité de la brûlure, de la latéralité de l'atteinte, de la qualité de peau de l'abdomen et dos. Si la littérature définit certaines étapes- clés dans la prise en charge, elle manque de données quantitatives concernant les différentes options et de résultats à long terme. Ainsi, d'autres données sont nécessaires pour déterminer si une technique est supérieure à une autre dans une situation donnée.*

Mots-clés : *brûlures thoraciques, brûlure du sein, reconstruction*

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Introduction

Burns involving the breast have long-term psychological and functional effects.[1,2] Post-burn deformities specific to the breast include scars, abnormal development of the breast mound, absence of the breast mound, asymmetry, distortion of normal breast architecture, and malformations or absence of the nipple-areolar-complex (NAC).[3-5] These complications can contribute to functional problems affecting breast feeding and chest wall movement, as well as psychosexual difficulties.[1,6]

Most breast burns occur in children and in the domestic environment. This is most frequently secondary to scalds (66-89%), flame burns (8-34%), and cooking oil scalds (2-5%).[7,8] In the UK, there are 130,000 emergency department attendances related to burns, 10,000 of which require hospital admission.[9] Figures for a 10-year cohort study reported that the breast and anterior chest wall are the most burned part of the trunk (96 patients admitted with breast burns).[10] Similar numbers (157 patients) were also reported in an 11-year cohort study.[11] Foley et al. reported 173/2581 (6.7%) children admitted to the Adelaide Burns Service over a 20-year period had anterior chest burns (inclusive of breast burns).[8] Despite these figures, there is relatively limited evidence in the literature for the optimum approach to breast burns reconstruction.[2,10]

Depending on the resulting defect, the reconstructive ladder can be applied to the management of some burns reconstruction.[12] In cases where the entire breast is lost through a burn, a reconstruction which restores volume, size and mass is required. In cases where the breast is scarred, both the intermammary and inframammary fold can be obliterated, abolishing the normal convexity and shape of the breast.[1,8] This would then require removal of scarred bands and scarred tissue to allow the breast to assume its natural shape. The final element includes breast surface appearance and texture, and this is possibly the most challenging. Restoring burned skin to appear like normal skin is not something which has been successfully performed without en bloc excision.[11] There are reconstructive approaches including flaps taken from unburned areas, use of full thickness skin grafts from redundant tissue, myocutaneous flaps, dermabrasion, and laser treatment.[3,10,13-16]

There are several elements of post-burn reconstruction that are not encountered during conventional breast reconstruction.[8,9,17-19] MacLennan et al. summarised the approach to the burned breast as: (i) management of the post-burn scar, (ii) restoration of breast shape and contour, and (iii) restoration of the NAC.[9] The goal of this approach is to provide the patient with a functional and aesthetically normal breast.

Method

Aims

This systematic review aims to establish currently available techniques for surgical management of the burned breast.

Review technique

This systematic review was performed in line with the Preferred Reporting Instructions for Systematic Reviews and Meta-analysis, and the Cochrane Handbook for Systematic reviews.

Search strategy

An electronic systematic search of the literature from 1970 to 2021 in the Pubmed/Medline database was conducted using the following MeSH Terms: “breast burns” OR “chest burns” AND “reconstruction” OR “surgery”

Inclusion and exclusion of literature

All retrieved abstracts were reviewed by two individual investigators. The retrieved abstracts’ references were reviewed for additional articles unidentified on primary search. Full manuscripts of articles fulfilling inclusion criteria were retrieved and studied. The data extraction was also conducted by two individual investigators.

This systematic review was limited to English language manuscripts. Articles with a focus on acute burns management were excluded. In addition, previous reviews, expert opinion articles, case reports and articles focused solely on nipple areola complex (NAC) reconstruction were also excluded. Paper abstract and titles were then screened in order to ensure included papers focused on breast mound reconstruction following burn injury.

Evaluation of included literature

The Oxford Critical Appraisal Skills Programme (CASP) tools[20] were incorporated to evaluate the included articles for bias, validity and applicability, and the National Institute for Health and Care Excellence (NICE) checklist for evaluating strength of evidence and recommendations for practice was utilised.[11,21]

Due to the inherently qualitative nature of the subject matter reflected in the content of the included articles, this review did not lend itself to quantitative analysis or meta-analysis. Instead, the 21-item checklist defined by EntreQ (Enhancing transparency in reporting the synthesis of qualitative research) was used.[12,22]

Results

The initial electronic literature search generated 1,385 abstracts. Of these, 22 studies were deemed eligible for inclusion. Exclusion of literature is summarised in *Fig. 1*. Included literature and associated recommendations are summarised in *Table I*.

Study characteristics

The total number of patients included were n=495 and n=>553 breasts. Six of the 22 studies did not specify the number of operated breasts. The median age at time of burn was 7.0 years (IQR: 4.3-8.3 years,

Table I - Summary of recommendations for breast burn scar reconstruction following resuscitation and patient stabilisation

INITIAL MANAGEMENT			
Pre-pubertal Breast Burn		**Post-pubertal Breast Burn**	
Recommendation	**Evidence**	**Recommendation**	**Evidence**
Tangential excision of dead tissue, allow for any eschar to demarcate, preserve the breast bud	[2]	Release axillary scars before breast scars	[25]
Wait until puberty for breast scar release.	[2]	All scars should be fully released including infra and intermammary release	[10]
SSG or a dermal substitute can be utilised as a bridging measure pre SSG/flaps to cover defect	[5,8,23]	Consider z-plasty or another local flap for release of breast scars.	[2,26]
Place Intercises of SSG in Langer's lines	[2]	Scar release should include inframammary 5/8ths of breast circumference +/- and supra and intermammary release.	[10]
Expand dermal substitute e.g. Integra for staged reconstruction	[24]	Recreation of the inframammary fold is an important consideration, for which reverse abdominoplasty has been shown to be an effective technique	[27]
		If the entire breast is lost/damaged, the patient will require a myocutaneous flap +/- implant is an option. Alternative strategies include a tissue expander or free flap.	[19, 28, 29]
		Utilisation of excess skin excised from the patient undergoing a cosmetic procedure for burns scar release/revision is also reported	[30]
		Flaps and full thickness skin grafts show less contracture vs. SSG and is an important consideration.	[31]

INTERIM MANAGEMENT	
Recommendation	**Evidence**
Local flaps reduce the need for scar excision	[2]
Advancement flaps for inframammary fold reconstruction with tissue expanders has been performed successfully but can require repositioning of the umbilicus	[27]

DEFINITIVE MANAGEMENT	
Recommendation	**Evidence**
Silicone conformer/moulded conformer helps shape the breast following scar release	[10]
If breast tissue lost because of burn injury, consider implant / musculocutaneous flap	[23]
Use of implant is only an option if there is sufficient overlying skin cover	[23]
Use of implant rarely required in east Asian women due to smaller average pre-burn breast size vs. Western women	[31]
Reconstruct breast using expander/implant/fat grafting + local flap/free flap e.g. DIEP/LD depending on the size and severity of the defect and status of back and abdominal skin	[2,18]
Wait for breast mound reconstruction to fully heal i.e. 6-12 months before attempting NAC reconstruction	[2]
Treat scars before implant insertion and insert below pec major if insufficient overlying soft tissue skin cover	[2]
Expand slowly, burned tissue expands slower vs. normal tissue	[2]
Scar revision and implant insertion in same operation can be performed	[13]
Leave expander in for 2-4 months, then replace with saline implant	[4,27]
Overexpand expander by 200ml in severe burns to ensure sufficient soft tissue available for reconstruction	[27]
The IMA is an effective perforator-based flap for sternal, unilateral burns in young patients performed with effective results.	[32]
Endoscopic insertion of breast expanders is a quicker operation with shorter mean time to full expansion compared with open insertion.	[4]
The earlier the reconstruction post pubertally, the better the long-term result	[25]
Avoid the TRAM flap in women who may become pregnant.	[33]

FURTHER MANAGEMENT	
Recommendation	**Evidence**
Symmetrising procedure on contralateral breast (mastopexy/reduction) often required, delay this until breast fully developed/healed from index procedure.	[14]
Inferior pedicle reduction is particularly effective in scarred and ptotic burned breasts.	[34]

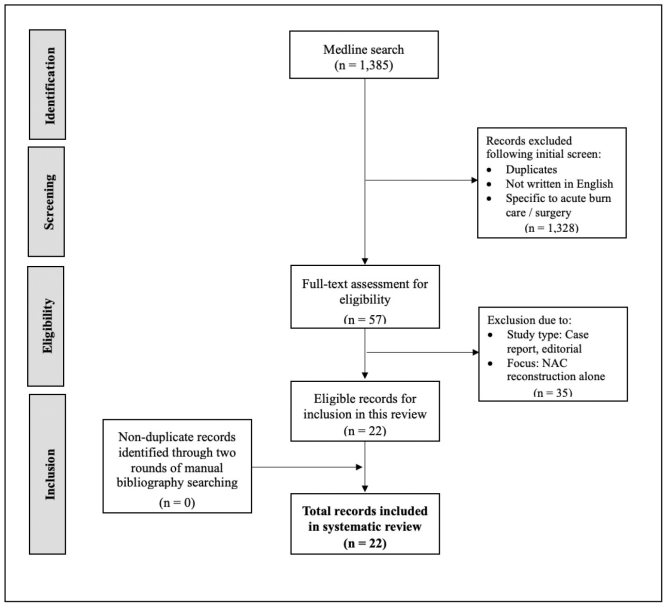

Fig. 1 - PRISMA diagram demonstrating search strategy results, inclusion/exclusion process, and final records included in this review

13/22 did not specify) and at time of reconstruction 22.8 years (IQR: 19.2-26.0, 8/22 did not specify). Average time for follow up was 44.1 months (IQR: 14.0-64.7 years, 14/22 did not specify).

Discussion

Breast burns reconstruction poses a unique challenge to the reconstructive surgeon with varied practices worldwide. Literature guidance particularly highlighted the benefit of an age-dependent approach to management. Literature emphasised the benefit of early tangential excision of the burn area with preservation of the breast bud in pre-pubertal patients.[2] Following this, early scar release at the onset of puberty is the second essential stage to allow unrestricted breast development.[25]

However, if the patient has lost the breast bud or the burn has been sustained in adulthood, then complete scar release is required prior to consideration of reconstruction.[10] Any axillary scars must be released first, followed by infra and intermammary scar releases as necessary.[10,35] The use of z-plasties or local flaps or skin grafts to aid in scar release has been well described as part of the armament of the reconstructive surgeon.[19] The outcome is not dependent on the type of scar release in so much as the principle of it. Echoing the fundamentals of skin grafting, evidence of the use of full thickness skin grafting with less primary contracture postulated a better cosmetic outcome compared to split skin grafting.[28]

In keeping with the advancements in technology, dermal substitutes such as Integra have found a role in staged reconstruction as a bridging mechanism.[5] Serial expansion of the dermal substitutes has shown some promise in that the skin grafts or local flaps post reconstruction show less contraction with its use.[5] Notwithstanding the downside of this are the multiple operations for expansion as well as the cost for the dermal substitute.[24] Completion of puberty is advised prior to any reconstruction, and the earlier the breast reconstruction post pubertal development, the better the long-term result.[35]

The next phase of reconstruction post scar release is as varied as the rungs of the reconstructive ladder, with use of skin grafts, local or free flaps, expanders, implants and fat grafting in stand-alone or various combinations. Autologous options such as skin grafting allow rapid healing of the breast but lack the replacement of any lost volume. Lipofilling is useful in small to moderate size defects but may require several operations due to the loss of the fat graft.[24] Pedicled flaps for augmentation of partial breast defects such as lateral intercostal flaps, thoracodorsal perforator flaps or advancement flaps can be useful. Larger breast defects can be reconstructed using regional or free flaps such as the latissimus dorsi and the deep inferior epigastric perforator flap.[23] Newer autologous free flaps that are yet to be utilised in burns breast reconstruction but are well documented in the literature for breast reconstruction, include the lumbar artery flap, posterior artery flap, gracilis myocutaneous flap, superior gluteal artery and inferior gluteal artery flap. The choice of free flap is determined by the size of breast volume required, availability of donor sites for reconstruction post burn, and the surgeon's preference along with the inherent nuances of each particular flap, such as pedicle length and size, the type of tissue quality and volume.[18,29,33,36]

On the prosthetic side, use of implants or expanders has been used to provide both volume and shape. Sufficient tissue coverage of the implant is necessary; this is to prevent both show and contour

defects. If there is insufficient tissue coverage, use of a myocutaneous pedicled latissimus dorsi flap or sub pectoral placement are to be considered.[13] Serial expansion and replacement with implant has also been described in the literature with various modifications, such as varying time for expansion as well as types of implant and pocket placement.[4] These time disparities can be accounted for by the fact that burned, scarred skin requires slower expansion than normal tissue. One study described both endoscopic and open insertion of expanders have been utilised successfully, with fewer complications reported in the endoscopic group.[4]

The new breast mound is left to settle for approximately 6 to 12 months prior to any other procedures such as nipple and areola creation.[2,10,13,19,27,35] Symmetrizing breast procedures such as breast reduction or mastopexy are also useful for cosmesis and only offered strictly once breast development has completed and can be synchronised with breast reconstruction of the affected breast to minimize the number of operations.[14]

Of the 22 included studies, 6 (27.3%) did not specify the number of operated breasts, 13 (59.0%) did not specify the median age at burn, 8 (36.4%) did not specify median patient age at reconstruction, and 14 (63.6%) did not specify average time for follow up. The lack of completeness of data impacts the power of our review. There was also a distinct lack of quantitative data on the aesthetic outcome of each reconstructive approach, and very limited reports of patient satisfaction with the results.[5,18,27] These patient and surgeon scores are also lacking over time, meaning the longevity of each technique is not well established. There are no randomised controlled trials or comparative results for various techniques as part of prospective cohort studies from the same institution in the literature. Surgical skill and technique may impact the way a specific technique was perceived by the writing authors.

Conclusion

In this systematic review relevant case series for breast mound reconstruction have been discussed. Recommendations based on the evidence include early tangential excision of burned breast tissue, with preservation of the breast bud, scar release at onset of breast mound growth/puberty. Techniques for reconstruction of the breast mound, as well as the appropriate context and application of those techniques have been discussed.

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