HEAD AND NECK SKIN EXPANSION: ASSESSMENT OF EF-FICIENCY FOR THE TREATMENT OF LESIONS IN THE LOWER HALF OF THE FACE

EXPANSION CUTANÉE CERVICO-FACIALE : ÉVALUATION DE L'EFFICA-CITÉ POUR LE TRAITEMENT DE LÉSION DE LA FACE BASSE

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SUMMARY. The treatment of sequelae for burns or other loss of perioral tissues is complex due to the site where they occur, its functional importance, and social and esthetic aspects. Functional consequences of burns to this area are cutaneous retraction and a lack of skin that can lead to an inability to close the oral aperture, compromising the provision of dental hygiene and intubation procedures. The aim of the present publication was to evaluate the efficacy of chin, labial and jugal cutaneous expansions for the treatment of perioral lesions and lesions of the lower half of the face in our retrospective series of patients. We collected data and photography from digital files for each patient. Proportion of scarred skin that could be treated by one or several expansion procedures was evaluated. The main outcome was the resection of 50% or more initial lesions. Side effects were assessed. Out of a total of 33 expanders, 28 were at the jugal level, 5 were chin expanders, and none were labial expanders. This equated to the inclusion of fourteen patients. The average percentage of the lesion that was removed after the perioral expansion protocol was 68.9% (40%-100%). 85% of patients had a positive outcome. 12% of procedures were complicated by hematoma, infection or prosthesis exposure. Each time that the lesional area could be fully (i.e. 100%) treated, only a single expansion was used. Head and neck expansion is the technique of choice for reconstruction of the lower half of the face and the horizontal part of the neck in terms of efficiency and safety.

Keywords: skin expansion, face reconstruction, burn scar, face scar, mouth rehabilitation, lip reconstruction

RÉSUMÉ. Le traitement des séquelles de brûlures ou d'autres pertes de substances tissulaires de la région péri buccale est complexe du fait de l'importance fonctionnelle de cette région et des conséquences esthétiques et sociales. Les conséquences des brûlures de cette région sont les rétractions ou la rigidité cutanées entrainant une limitation de la fermeture buccale et de ce fait compromettant l'état dentaire et les procédures d'intubation. Le but de ce travail est d'évaluer l'efficacité de l'expansion cutanée du menton, des lèvres et des joues dans le traitement des lésions de la région péribuccale ou de la face basse par une étude rétrospective de notre série. Nous avons repris les données cliniques et les photographies à partir des dossiers informatisés pour chaque patient. Nous avons évalué la quantité de peau cicatricielle traitée en un ou plusieurs temps. Le résultat principal est que plus de 50% de la lésion initiale a été traitée. Les effets secondaires ont été évalués. 14 patients ont été inclus. 33 expandeurs ont été posés, 28 étaient au niveau de la région péribuccale était de 68,9% (40%-100%). 85% des patients ont eu un résultat satisfaisant. 12% des procédures d'expansion se sont compliquées d'hématome, d'infection ou d'exposition de la prothèse. A chaque fois que la lésion pouvait être traitée totalement, une seule procédure a été réalisée. L'expansion cutanée de la tête et du cou est la technique de choix pour la reconstruction de la face basse et de la portion horizontale du cou en termes de résultats et de complications.

Mots-clés : expansion cutanée, reconstruction faciale, cicatrice de brûlure, cicatrice de la face, réhabilitation buccale, reconstruction labiale

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Introduction

The treatment of sequelae from burns and other tissue loss by cutaneous expansion is a wellknown and widely used technique. The expansion can be situated in direct contact with the area to be reconstructed so as to perform a local pre-expanded flap, or further away to perform a regional pre-expanded flap that will be followed by a local or distal expansion so as to achieve a pre-expanded full skin graft.

Use of healthy juxta-lesional skin has the advantage of being similar in terms of pigmentation, hairiness, thickness and texture. In light of this, jugal, chin or labial cutaneous expansions are considered to be particularly suitable for treating perioral lesions. They can however be the cause of certain consequences for the donor site, such as the appearance of stretch marks, loss of cutaneous elasticity, or a decrease in hair density either on the scalp or on the beard area for men.

The treatment of sequelae for burns or other loss of perioral tissues is complex due to the site where they occur, functional importance, and social and esthetic aspects. It is a motile area, with concave and convex features and a complex muscle structure for which deformities can appear upon movement or only when relaxed. Functional consequences of burns to this area are cutaneous retraction and a lack of skin that can lead to a labial ectropion, microstomia, the formation of flanges and consequent labial incompetence, and an inability to open the oral aperture which compromises the provision of dental hygiene and intubation procedures. In terms of esthetics, asymmetry, alopecia and discoloration are to be added to the functional sequelae. Thus, elocution, mastication, and mimicry are also part of the rehabilitation process.

From a cosmetic point of view, the reconstruction and the resurfacing of this area must also take into account the esthetic subunits of the face.¹

Despite the frequent use of expanders in plastic surgery, there are few publications regarding perioral cutaneous expansion.²

In 1994, Kawashima deemed cutaneous expansion to be the best solution for reconstruction in cases of cutaneous facial defects.³ With a series of 23 patients, they found that good esthetic outcomes could be achieved as the technique allowed for use of adjacent skin with similar characteristics to the area to be reconstructed, such as texture, hairiness and thickness. The technique depends largely on the number of expansions, the characteristics of the prosthesis, the approach, and the local flap that is subsequently performed. Results for reconstruction of the upper and lower lips as well as the eyelids indicate that the technique entails a risk of ectropion.⁴ A study involving a series of 16 patients published by Grishkevich in 2015 regarding the use of jugal and cervical expanders for total resurfacing of the cheek after an advancement flap revealed good functional and esthetic outcomes, with complete replacement of the affected area after one or two series of expansion.⁵

With children, the use of expanders has yielded convincing outcomes, particularly for the treatment of giant congenital nevi, hamartomas, as well as sequelae for burns and scarring.⁶ In this study, expansion of the scalp was considered to be the safest site, with fewer complications than expansions of the face due to the abundant vascularization. A decrease in hair density associated with skin refinement can however be expected, with as a consequence an increase in the risk of exposure that is proportional to the number of expanders placed.

According to Tao Zan, expansion of an area such as the cheek or the chin can be undertaken straightaway in the setting of sequelae for burns that are restricted to the perioral esthetic subunit without involvement of surrounding areas, while in cases of more extensive or widespread burn sequelae treatment involves a regional expansion (e.g. cervical, supraclavicular).⁷ They studied the various therapeutic outcomes with a series of 180 patients suffering from burn sequelae. One hundred and seventy-four patients underwent a cutaneous expansion for the face, the neck, or the thorax. The rate of complications was 5.38%, and these mainly comprised swelling of the prosthesis, infections and hematomas.

The aim of the present publication was to evaluate the efficiency of chin, labial and jugal cutaneous expansions for the treatment of perioral lesions and lesions of the lower half of the face in our series of patients, as well as to determine the proportion of scarred skin that this procedure can treat.

Materials and methods

All of the patients in this retrospective study underwent a perioral cutaneous expansion in the Plastic Surgery Units of the Rothschild Hospital or the Saint-Louis Hospital between January 2005 and July 2016.

To be included, patients had to have undergone placement of one or more expanders in the jugal, chin or labial areas. Medical data, photographs and reports regarding the surgery were obtained from the digital files. Patients who were either deceased, minors, or lost from follow-up were excluded from the study.

The data collected for each patient comprised: their gender, age when the burn or the lesion occurred, the etiology of the burn or of the lesion in question, the site of the burn, the date of the first expansion, the expanded area, and the proportion of sequelar skin that was treated once the procedure had been completed.

The expanders had a rectangular, round or customized shape, with a silicone envelope, and an internal inflation port distal to the site of the expander. Physiological serum was injected daily after the access site used to place the prosthesis had undergone a sufficient degree of wound healing.

We considered the skin expansion procedure to have been efficient if 50% or more of the initial lesion was removed.

Results

Out of a total of 33 expanders, 28 were at the jugal level, 5 were chin expanders, and none were labial expanders. This equated to inclusion of four-teen patients in our study (8 women and 6 men) (*Table I*).

They were between 21 and 66 years of age upon

the first placement of an expander.

Twelve patients exhibited sequelae for burns to the face, eight of whom also had burns to the hands, thorax, abdomen and limbs, while two had suffered sequelae from bites, as summarized in *Fig. 1*.

Six patients were operated on just once to place a single jugal expander.

Four patients were operated on twice, three underwent surgery three times, and one had surgery five times (*Fig. 2*).

The volume of the expanders varied from 45 to 320 mL with an average volume of 113 mL, and two of the prostheses were custom-made. For two expanders, external valves had to be placed in light of the poor quality of the adjacent skin. For all of the other cases, the valves were internal and distal to the expander so as to limit the risk of infection.

Out of the 33 expanders, 4 (12%) exhibited complications: a valve exposure led to replacement of the valve without changing the prosthesis, and the expansion was fully completed. One prosthesis became infected, which led to its ablation, while two hematomas led to ablation of the expanders (*Fig. 3*).

Once the protocol had been completed, we reviewed the set of patients so as to quantify the size of the area that could be treated. The expansion protocols were deemed to have been completed when the sequelar area had been fully (i.e. 100%) treated (three cases), or when it was no longer possible to perform head and neck expansion in light of the extremely compromised nature of the perilesional area (11 cases).

The average percentage of the removed lesion after the head and neck expansion protocol was 68.9% (40%-100%). Each time that the lesional area could be fully (i.e. 100%) treated, only a single expansion was used.

For the 8 patients who underwent several cutaneous expansions (2 to 5), the average extent of healing was 58.75% (40%-80%). It was in fact never possible to treat the entire sequelar area. For these 8 patients, more than 75% of the final extent of healing was achieved with the first expansion.

At least, 85% of patients achieved the main outcome, which was the resection of 50% or more of the initial lesion.

Table I - Patient data

	Gender (M/F)	Age at burning (years)	Etiology	Age at first expansion procedure	Area	Custom- made prosthesis	Volume (mL)	Complica- tion	Associated lesions/burns	Proportion of removed scarred skin
Patient 1	F	45	Thermal burn sequelae of the face	47	2 cheeks (2014) + chin and cheek on the left (2015)	Cheeks : no, chin : yes	45 and 60 (cheeks); chin : unknown	Unknown	Neck and anterior part of trunk	70%
Patient 2	М	Unknown	Thermal burn sequelae of the neck	39	Left cheek (2002)	No	160	No	Thorax, arm and shoulder	100%
Patient 3	М	27	Chemical burn sequelae of the face	28	Right cheek (2012), left cheek (2015)	No	200, 160	Valve expo- sure for the left cheek prosthesis	Eye ball destruction	60%
Patient 4	F	26	Chemical burn sequelae of the face after caustic ingestion	30	2 cheeks (2014)	No	180 x2	No	Thorax, neck, shoulder, oesophagus and stomach	65%
Patient 5	F	Unknown	Thermal burn sequelae	21	Chin and 2 cheeks (1996), 2 cheeks (1998)	No, exter- nal valve (1997)	100 (cheeks), 160 (chin), 200 (right cheek1998), 100 (left cheek 1998)	Chin prosthe- sis infection, scar opening, prosthesis exposure	Thorax and arms	50%
Patient 6	М	16	Thermal burn sequelae	28	Left cheek (2010)	No	320	No	Scalp, ear destruction	50%
Patient 7	F	30	Thermal burn sequelae of the neck	34	Right cheek (2008)	No	100	No	Abdomen and armpit	75%
Patient 8	F	Unknown	Preauric- ular thermal burn	21	Right cheek (2016)	No	190	No	No	100%
Patient 9	М	43	Thermal burn sequelae of the face	45	Left cheek (2012), left cheek (2014), left cheek (2016)	No	100 (2012), unknown (2014), unknown (2016)	No	Left ear, right forearm	80%
Patient 10	F	7 months	Thermal burn sequelae	32	Chin (1995) 2 cheeks (1996) 2 cheeks (1999)	No	$ \begin{array}{c} (1910)\\ 160\\ (1995),\\ 100\\ (1996),\\ 100\\ (1999) \end{array} $	No	No	40%
Patient 11	М	Unknown	Thermal burn sequelae of the lower lip	37	Chin x2 (1997), 2 cheeks (1998), left cheek (1998)	No, exter- nal valves	160cc x2 (1995), 100 (1998), 100 (1998)	Unknown	No	65%
Patient 12	F	Unknown	Dog bite sequelae of the left cheek	26	Left cheek (2015)	No	160	Hematoma	No	100%
Patient 13	М	Unknown	Thermal burn sequelae	30	Left cheek (2009), right cheek (2010 x2)	No	Unknown (left cheek 2009), 200 right cheek (2010), right cheek 200 (2010)	Hematoma with prosthe- sis explanta- tion	Both hands	40%
Patient 14	F	65	Dog bite sequelae	66	Left cheek (2015)	Yes	Unknown	No	No	70%



Fig. 1 - Kind of lesion on males and females



Fig. 2 - Necessary number of expansion procedures



Fig. 3 - Complications

Case N°1 – *Treatment of palpebral lesions (Figs. 4-8)*

- The patient suffered chemical burns at 27 years of age.
- Treatment was initiated 12 months following the burn.
- Exhibits left-side palpebral scars with destruction of the left eye socket. The right eye is shiny with chronic suppuration that re-

quires urgent treatment.

- First expansion with right-side jugal prosthesis with a volume of 200 ml obtained after 6 inflations.
- Performance of an anticlockwise rotation flap of the right-side cheek after resection of the retractable scar tissue of the right-side periorbital area and creation of a new palpebral fissure in the flap in relation to the eye socket.
- Palpebral fissure that provides proper protection of the functional eye, absence of retraction or deformation of the nostril, of the eyebrow or the right labial commissure and location of the scar in the nasogenian and the allogeian grooves.
- Second expansion of the left-side cheek to treat the left-side palpebral retraction with a rectangular prosthesis of 160 mL and then ablation of the prosthesis and performance of an upward and rearward advancement flap of the left cheek to resect the left-side subpalpebral retractile scar tissue.



Fig. 4 - Preoperative lesions



Fig. 5 - Perioperative photographs of the performance of a rotation flap after expansion with a prosthesis of 200 mL



Fig. 6 - Post-operative results at 12 months. Note the absence of deformation of the nostril, the eyebrow or the right labial commissure and location of the scar in the nasogenian and the allogeian grooves



Fig. 7 - Photograph taken during the left jugal expansion



Fig. 8 - Post-operative results at 6 months

Case N°2: Treatment of perioral lesions (Figs. 9-11)

- The patient suffered acid burns at 26 years of age.
- Exhibits perioral scar tissue responsible for a labial and commissural flange that impairs opening of the oral cavity. Substantial discoloration of the scar. This scar tissue is in continuity with a mediocervical and right laterocervical flange.
- Placement of rectangular expanders for the cheeks, each with a volume of 180 cc, four years after the burn. Concomitant placement of a round inflatable prosthesis from the left shoulder. The maximal inflatable volume was obtained after 7 inflation sessions.

- Removal of the prostheses and performance of a downward and forward advancement flap of the cheeks so as to resect the perioral and upper cervical scar tissue.
- Clinical examination at a later date showed that there is still a labial ectropion, even though it is reduced, and a decreased size of the cervical flange with improvement in cervical mobility.



Fig. 9 - Preoperative lesions



Fig. 10 - Expansion taking place with jugal prostheses of 180 mL on each side



Fig. 11 - Post-operative results 12 months after removal of the expanders and performance of the advancement flap of the cheeks. Note that the labial ectropion is still present, even if it is reduced, and a decrease in the size of the cervical flange and improved cervical mobility

Discussion

Several types of techniques have been described for reconstruction of the perioral area.

Grafting of thin skin represents a straightforward solution that takes little time to perform. It has numerous drawbacks however, both in terms of esthetics (e.g. different texture, patch-like effect) and function (e.g. retraction). A number of teams have reported cases of total skin grafts involving a large surface area so as to graft an entire face exhibiting sequelae from burns in one go.⁸ Subsequent evaluations revealed good functional results in terms of the perioral flanges, although with a mediocre esthetic appearance due to the graft being crural with a "mask-like" pigmented effect.

The alternative to a total skin graft is reconstruction with an artificial dermis covered with thin skin. The study by Demircan regarding the use of an immediately grafted dermal matrix after a burn for facial reconstructions in children revealed a better final appearance compared to only a cutaneous graft in terms of vascularization, color, trophicity and elasticity. The healing time remained the same, while the follow-up treatment was more straightforward since only a single surgical procedure was required.⁹ Nonetheless, the high cost and the difference in texture and in pigmentation remain the principal limitations for this technique.

For their part, Foyatier has shown that facial reconstruction after burns with a mainly supraclavicularly derived total skin graft - whether pre-expanded or not - provides satisfactory functional and esthetic outcomes, provided that the proper technique is strictly adhered to and due consideration is given to the esthetic subunits of the face.¹⁰

If the lesion or the sequelae of the burn to be treated is small in size and situated in proximity of a healthy region, a Z or V-Y type of local plastic surgery flap can be used. If the lesion is in regard to an isolated flange, a cheek advancement flap can be used, or a nasogenian flap if the lesion is located at the level of the lip.¹¹ Reconstruction of the vermillion can require a mucosal advancement flap. Use of such flaps does not allow for reconstruction of large cutaneous surfaces.

If the only available healthy skin is situated at the cervical level, a regional flap can be a consideration. A laterocervical rotation flap can be carried out for example if reconstruction of a man's beard is needed.

The study by Chen, who investigated facial-cervical-pectoral rotation flaps in 12 patients to cover loss of transfixing tissue of the cheek after a tumor, showed that the rate of complications with such flaps was 25%, and these solely comprised disunions and partial necroses, yielding a final appearance that was deemed to be acceptable to the patients and a low level of morbidity at the donor site.¹²

Very rarely, in cases of substantial lesions or scar tissue, indication for a free flap can be considered. A radial antebrachial flap is the most suitable due to its limited thickness and the ease of its removal. Performing an anterolateral thigh flap is more complex and its thickness necessitates alterations to make it thinner, although it does have the advantage of not sacrificing a vascular axis. Free flaps are major interventions with a substantial risk of failure, and they should be carried out after evaluating the risk-benefit ratio.

Vu Quang, whose publication is in regard to a study of parascapular free flaps for facial reconstruction in the context of sequelae from burns, showed in their series of 17 cases that the rate of complications involving infection, partial or total necrosis, or hematoma reached 12%, with satisfactory functional outcomes, albeit with mediocre esthetic appearances.¹³ Two free flaps needed to be placed for total necrosis.

In light of this, performing local perioral expanded flaps seems to us to be the technique of choice for treatment of the sequelae of burns and loss of perioral tissue. A major advantage of local pre-expanded cutaneous flaps over other techniques is that they provide a similar skin. They can be used for the reconstruction of numerous areas, from the pretragal area to the horizontal part of the neck, or even for the eyebrow area, the lips and the cheeks. The presence of a cutaneous surface in proximity of the area to be treated is indispensable and it determines the reconstruction strategy.

Although this technique can lead to certain complications, such as hematomas, infections, exposure of the prosthesis, as well as social awkwardness during the time of expansion or restrictions such as procedures being repeated, it remains reliable since only a single expander (3%) had to be removed before the end of the expansion procedure.

As the expander is an implanted foreign body, it causes a local pericapsular periprosthetic type of reaction. In certain cases, similar to permanent implants, a callus-like entity may arise, thereby compromising the expansion and decreasing compliance and cutaneous elasticity. This complication can sometimes require renewed surgery so as to weaken or remove the problematic callus, and it can increase potential risks such as bleeding. The presence of such a callus can consequently limit the extent of the advancement or rotation of the pre-expanded local flap.

The frequency with which such calluses occur is proportional to the number of expansions performed, and they are even more of a problem when the cutaneous surface that is to be reconstructed is large and requires several expansions.

There are technical differences in regard to the sites for the introduction of expanders.

Labial expanders are rarely used and they are the hardest to perform. Indeed, it is difficult to obtain the correct dissection planes due to the numerous muscles that are intertwined with the skin and the mucosa. This mucosa is also too fine a structure to support expansion, and its use could increase the risk of exposure and infection of the prosthesis, given the number of anaerobic microorganisms of the oral flora. Furthermore, the position of such prostheses hinders food intake and patients tolerate them poorly.

By contrast, cheek expanders are used more frequently and they offer larger surfaces for expansion that can be undertaken several times. They can be used to perform expanded regional flaps for reconstruction of periorbital and perinasal areas, the lips, the horizontal part of the neck, and the pre-auricular area. In men, a jugal expansion results in a depletion of hair follicles and a decrease in the density of the beard. Furthermore, the reconstruction strategy is different with men, particularly when only the healthy cutaneous area is hairy and the area to be reconstructed is hairless. In our series, they are however the only ones that allowed a complete treatment of the sequelar area.

Expanders of the chin are used more rarely due to the difficulty with dissection and the small surface that can be expanded. The convex component of the area compromises reconstructions of the concavity above the vermillion border, and performing a local flap may lead to an ectropion of the lower lip. They can be used in a more limited manner than expanders of the cheek to perform expanded regional flaps to reconstruct the horizontal part of the neck and of the lower lip.

In our series, only three patients could be fully treated by a cutaneous expansion. For each case, it involved jugal expanders that only required a single procedure. In light of the relatively substantial surface and the quality of the jugal skin, it is not surprising that it is the donor site of choice for perioral expansions.

For our entire series, 68.9% of the sequelar area could be resurfaced by cutaneous expansion. It is interesting to note that nearly 75% of the final resurfacing achieved was from the first expansion series. Repeated expansions are often less effective due to the scarred and fragile nature of the tissues. Thus, the cutaneous benefit obtained often becomes more modest over time. Nonetheless, even if the lesion cannot be fully resurfaced, it sometimes allows (Fig. 8) for adequate restoration of the face, leaving it up to other techniques to treat the less exposed areas (e.g. shoulders, the thorax, etc.). When devising a therapeutic approach, restoration of the face should be emphasized and given priority status as it is often the main cause of functional (e.g. labial ectropion, etc.) and esthetic issues.

Conclusion

Head and neck expansion is the technique of choice for reconstruction of the lower half of the face and the horizontal part of the neck.

While labial expansion is only of a little interest due to the limited benefit that can be expected and its technical difficulty, expansion of chin and particularly jugal skin are suitable techniques for reconstruction of the lower half of the face and the horizontal part of the neck. When devising the protocol, it is important to inform the patient about the ensuing social pressure and to ensure that they will fully comply with the undertaking.

In light of an average coverage of 68.9% of the lesional areas, it is paramount from the outset to seek to correct the most troublesome areas for the patient. Thus, in case of an incomplete result, it will be the less exposed areas and hence less disabling such as the neck and the shoulders that will be treated by grafts or flaps for which the esthetic outcomes (e.g. pigmentation, thickness of the cu-

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