Background: The edge shoulder posterior adduction contractures are insufficiently researched. It concerns the anatomy and scar surface insufficient as contracture cause and anatomical substantiation of the used surgical techniques. Shoulder posterior and anterior contractures have several names on reflecting real contracture anatomy; main surgical technique is Z-plasty, in which triangular flaps do not match scar surface deficit. As result, a surgical rehabilitation of burned patient is far from perfect. These factors were the reasons that prompted the exploration of several aspects of shoulder posterior contractures with a purpose of developing more efficient curative methods.

Methods: Fifty-seven patients with edge scar shoulder posterior adduction contractures were personally operated, and the contracture anatomy and contracture cause explored, adequate surgical technique and flaps for scar surface deficit compensation and contracture elimination were researched pre surgery, during operation and after reconstruction. The obtained data opened new vision on anatomic diagnosis formulation and, surgery planning, donor site choice and adequate flap formation, and served as the basis for development of a more effective reconstructive technique.

Results: Posterior shoulder edge scar adduction contracture is caused by scars covering the joint posterior flexion lateral (FL) surface and forming the fold. The scars of the FL surface and fold have scar surface deficit (Dt) of trapezoid form (wound appearing after dissection scars of FL surface), located between the shoulder and chest wall. Scar surface deficit adducts shoulder and spreads from the fold’s crest to the joint rotation axis (8-12 cm and more) and. The end of the trapezoid wound (surface deficit) at the level of the joint rotation axis is 4-6 cm. Form and size of the scar surface deficit determine the use of the similar (trapezoid) flap needed for adequate scar surface deficit compensation and complete contracture elimination. A perfect donor site is axillary fossa and sheets of the fold; the axillary adipose-cutaneous trapezoid flap cover the trapezoid wound, appeared after FL scars dissection with Y-incision, compensates the scar surface deficit and contracture eliminates. The donor wounds aside the flap are covered with local trapezoid adipose-scar flaps prepared from the fold’s sheet. Excellent outcomes allowed us to avoid the use of skin transplants, triangular and complex flaps and traumatic procedures.

Conclusion: New data, concerning the anatomy of the edge shoulder posterior adduction contractures, their form, and location of scar surface deficit and donor site allowed us complete contracture elimination by scar surface deficit compensation, using all axillary fossa tissues in form the adipose-cutaneous trapezoid flap and the original trapeze-flap plasty. Excellent/good outcomes without complications and re-contracture possible to avoid the less effective triangular flaps use and make surgical rehabilitation of burned patients more effective.
contractures treatment sufficient for the release of the edge contracture. Balumuka et al. [5], had 60% re-contractures after treatment of shoulder and elbow joints. Contracture recurrence is a result of incomplete contracture release and complications. Therefore, repeated reconstruction is often needed [6]. Presented published data and our clinical experience showed that the anatomy of scar contractures needs further exploration and the development of more effective techniques should continue.

**MATERIALS AND METHODS**

**Patients**

Fifty-seven patients with postburn shoulder posterior adduction contractures were operated personally; of them, 8 patients had edge posterior contractures of both shoulder joints; 31 were men and 26, women; ages 5 to 65 years; 17 were children. TBSA was 12- 54 %, mean, 23%. Twenty-two patients had combinations of shoulder posterior adduction contracture with elbow or/and wrist scar contractures which were released simultaneously.

**Methods**

Contractures anatomy and contractures cause (scar surface deficit) were carefully studied and fixed on pictures before operation, during surgery and 6 months to five years after reconstruction. In the research program were included: (a) contracted scar location, (b) contracture formation; (c) scar surface deficit form and location, (d) fold formation and its meaning,(f) research an adequate flap and (g) development effective method for shoulder posterior contracture elimination. Full shoulder abduction (180 degrees) and range of joint rotation were considered as good/excellent results. Shoulder posterior contracture (numeric classification) is edge contracture of own classification, which is used in this paper [3].

**RESULTS**

The research of the anatomy of edge scar contractures (before and during operation, as well as the outcomes) provided the authors with new data that completely changed the view of all aspects of this post burn pathology, and what is especially important, brought the surgical rehabilitation to a new level.

**Functional zones of the shoulder joint surface in case of edge posterior contracture in adult and children**

Planning surgery, it is necessary to divide the shoulder joint’s surface into flexion (F) and extension (E); the boundary between them passes along the joint rotation axis level (symbol “+”). The flexion surface (F) of big joints has a curvature of nearly 90 degrees, caused by latisimus dorsi and pectoralis major muscles edges which divided it into two parts: flexion lateral (FL) surface and flexion medial (FM). During burn, a shoulder adducts to chest wall and thus prevents fossa or joint FM surface from injury. The divided line passes along the edge of the axillary fossa. The posterior FL surface spreads from the posterior edge of the joint fossa, or crest (Cr) of the fold (Fd) (in case of edge posterior adduction contracture) to the joint rotation axis level. The flexion medial surface lies between fossa edges. Contracture type formation depends on the contracted scars location: shoulder edge posterior contracture is caused by scars covering the posterior flexion lateral surface; the flexion medial and extension surfaces stay undamaged (Figures 1A-D).

**Edge shoulder posterior contracture formation**

Edge shoulder posterior adduction contracture is caused with burn and scars, covering posterior surface of the shoulder joint or flexion lateral surface (FL), from the fold crest (Cr) to the joint rotation axis (+). During wound healing, scars grow distally, among the shoulder and chest wall. Moving distally, scars involve the healthy skin of axillary fossa. As a result, the crescent-shaped fold is formed (Fold or Fd), located along the posterior edge of axillary fossa. The lateral fold sheet is scars and a part of flexion lateral surface which becomes wider (distance from the fold's crest to the joint rotation axis). Axillary fossa and medial fold sheet stay undamaged (Figure 1).

**Anatomy of shoulder edge posterior adduction contracture**

Our observations showed that shoulder edge posterior aduction contracture has specific anatomic and clinical features: (a) contracture is caused by scar which cover the shoulder joint’s posterior flexion lateral surface (FL) and which spread from the crest of the fold (Cr) to the joint rotation axis (“+”), (Figure 1AC); (b) scars of flexion lateral surface (FL) grow distally, involving of fossa's healthy skin and thus form a fold; this fold passes along posterior edge of axillary fossa. (c) The fold consists of two...
different quality sheets: lateral is scar and continuation of the RFL surface, the lateral scar participates in contracture formation. The medial fold's sheet is healthy skin and continuation of the healthy skin of axillary fossa or FM surface. (d). The crest of the fold (Cr) is the edge of scars and passes along the fossa's edge, between FL and FM surfaces.

These four anatomic features and clinical signs determine the scar contracture name, edge, and are constant independent of contracture location and severity and is basis of diagnose. In case of edge shoulder posterior contracture, the distance from the fold crest to the joint rotation axis (the width of contracted scars), is from 6-8 cm (in children) to 10-12 cm and more in adults (Figure 1, 2A-D and 3A).

Scars of the FL surface, growing distally and forming a lateral sheet of the fold, involve (stretch) the healthy skin of fossa (FM surface) which also grows and form medial healthy sheet of the fold, increasing the surface of axillary healthy skin. Thus, the fold is new valuable anatomical structure and new plastic tissue suitable for scar surface deficit compensation and contracture elimination. The more expressed is the fold, the easier becomes the contracture elimination with local tissues.

Surface deficit of contracted scars is the contracture cause

The scars of flexion lateral surface, growing distally, form the lateral scar sheet of the fold and, thus, increase flexion lateral surface (FL) in width, from the fold crest to the joint rotation axis (Figure 1). Simultaneously, the scar underwent contraction in length and shorten the scars of flexion lateral surface between the shoulder and the chest wall on all extent or from the fold's crest to the joint rotation axis and abducts the shoulder to the chest wall (Figure 1-8). Thus, the edge shoulder adduction contracture is caused with scars covering the joint flexion lateral surface (from the fold’s crest to the joint rotation axis) which have the surface deficit in length (among the shoulder and chest wall). In others words, the edge posterior contracture is caused by the surface deficit in length of the scars, covering the flexion lateral surface and lateral scar sheet of the fold (Figure 2 and 3).

The size and form of scar surface deficit causing contracture

Exclusively important to know the form and size scar surface...
deficit and is there scar surface deficit at the joint rotation axis level and has a definite lineal size, or fully disappears. Clinical observations show, that after contracted scars dissection with lineal incision from the fold crest to the joint rotation axis, complete contracture release is not achieved because wound edges are not fully divergence as tissues of joint extension surface (E) and skin of medial sheet of the fold with flexion medial surface are tightly connected with contracted scars of flexion lateral surface and the lateral scar fold sheet. After separation scars from healthy skin by incision along the fold crest and scars dissection with lineal incision, the wound appears having triangular form; the acute angle of the wound concurs the joint rotation axis where the wound edges not divergence and contracture not fully released (Fig. 2, 3&5).

In order to fully scars edges divergence, complete contracture elimination, and to determine the form and sizes the scar surface deficit, it is necessary to separate the contracted scars: (a) from the healthy skin of axillary fossa or flexion medial surface (FM)

Figure 3a Treatment of left shoulder edge posterior contracture, caused by scar surface deficit of join FL surface and lateral fold’s sheet, by trapeze-flap plasty (three trapezoid flaps). (A) Pre-surgery; anatomy of edge contracture and planning.

Figure 3b Contracted scars dissected from the fold crest to the joint rotation axis with a Y-incision; large trapezoid wound appeared (right from the strip) or deficit scar surface has M-form on joint rotation axis level, nearly 5 cm in length.

Figure 3c,d Adipose-cutaneous axillary flap mobilized and transposed on the wound.

Figure 3e Donor wounds aside the flap covered with adipose-scar trapezoid flaps prepared from the scar sheet.

Figure 3f Three weeks after reconstruction: contracture removed, flaps alive.

Figure 3g Excellent functional and cosmetic outcomes.
with an incision along the fold’s crest, and (b) from the scars on joint extension surface (E) with an radial incision and along the joint rotation axis level by Y- or Y-shaped incision (Figure 2B,3B). The latter incision is preferable, as a Y-incision creates M-shaped wound end along the border with joint extension surface and allows for easy divergence of scar edges while the shoulder abduction. During the shoulder abduction from 90 degrees to 180 degrees, the scars freely diverge and the wound and its end increases nearly twice, reflecting the true scars surface deficit and contracture cause. Then, the flaps end is dissected at 2 cm in depth to reach the M-wound’s end (Figure 8C,9C). The end of the M-shaped wound is length of the scar surface deficit at the level of the joint rotation axis. Consequently, the trapezoid wound is the form and size of the scar surface deficit and is the true cause of scar contracture. The form and size of scar surface deficit determines an adequate flap (trapezoid) and technique (trapeze-flap plasty) choice, efficacy for scar surface deficit compensation and contracture elimination with local tissues.

**Edge shoulder posterior contracture treatment with trapeze-flap plasty**

Edge shoulder posterior contracture treatment is concluded in (a) defining contracture cause or scar surface deficit by contracture release with Y-incision, (b) scar surface deficit compensation with axillary adipose-cutaneous trapezoid flap and (c) donor wound resurfacing using the fold sheets (Figure 2,3,5,7). First, the operation planning takes place: one-, three or five-flap trapeze-flap plasty (Figure 2A,4B,7A,B). Technical details: (a) scars causing contracture are separated from healthy skin: medial fold sheet with incision along the fold crest and tissue of joint extension (E) surface with Y-incision of contracted scars from the fold’s crest to the joint rotation axis. Trapezoid wound or scar surface deficit is appeared in joint FL surface (5D). (b) The length of the surface deficit at the joint rotation axis is 4-6 cm (Figure 2B,3B,5D). The scar surface deficit compensation and contracture elimination is achieved by the big adipose-cutaneous flap mobilization from axillary tissue and medial fold sheet and transposition on the wound. (c) The donor wounds aside the flap are covered by displacement of the lateral scar sheet to the flap’s base (Figure 2,3); more often the adipose-scar trapezoid flaps are prepared from the lateral scar sheet (Figure 4,5).

**Treatment mild to moderate contracture elimination with one adipose-cutaneous trapezoid flap**

The excellent donor site for this flap is axillary fossa and the medial fold sheet. Functional zones and planning of operation is showing in Figure 2A and 3A. Operation consists in the fold’s sheets separation; contracted scars of the scar sheet and flexion lateral surface the scar sheet with subcutaneous fat layer are dissected from fold crest to the shoulder joint rotation axis by Y-shaped incision. After shoulder abduction, scar borders divergence forms a trapeze-shaped wound. According to wound’s form and size, the trapezoid flap is mobilized. Medial fold’s sheet and axillary fossa’s adipose-cutaneous layer up to pectoralis major muscle are included in the flap. A deep axillary fat layer and lymphatic nodules stay in situ. The flap’s end includes a part of the fold crest; its width is nearly 5-6 cm. Flap’s end is dissected 2-3 cm in depth, and flaps are transposed on the wound with tension. As result of flap tension, the axillary edges approach, the donor wound is diminished due to displacement of neighboring tissues of joint extension (E) and anterior flexion lateral surfaces to the axilla, participating in donor wound covering and contracture elimination. The M-shaped flap’s end is sutured with scar’s M-form wound’s end, and the donor wounds aside the adipose-cutaneous flap are covered with the lateral scar sheet approaching its angles to the flap base (Figure 2,3).

Moderate edge shoulder posterior contracture elimination with three trapeze flaps

Vast burns resulted in the long fold formation causing the edge posterior shoulder and medial truncal lateral contractures. Functional zones, anatomy, and planning of both contractures’ reconstruction is showing in Figures 4A and B. Vast burns resulted in the long fold formation causing the edge posterior shoulder and medial truncal lateral contractures (Figure 4). If the contracture and scar surface deficit is severe, the angles of the scar sheet can’t reach the flap’s base in order to cover the donor wounds; therefore; two additional trapezoids adipose-scar flaps are prepared from the scar sheet and transposed on the wounds located aside the main flap. The wounds aside the flap scars are covered with the angles of healthy sheet. Simultaneously, the medial truncal scar contracture is reconstructed (Figure 4C,D).
Severe contracture elimination with several adipose-cutaneous and adipose-scar trapezoid flaps

Severe contractures are usually caused with long well protruded fold (Figure 5 A,B). Anatomy and joint functional zones of severe posterior edge shoulder contracture is showing in Figures 5A-C. At the first, the central zone of contracture is reconstructed in usual manner, with 3 trapezoid flaps (Figure 5D). Then, the fold's sheets on all its extent are converted into the trapezoid flaps, up to fully contracture release with some over-correction (Figure 5E-G).

In children, after contracture release, the strips of rough scars useful to excise on shoulder and chest wall with primarily wound closure (Figure 6A-C). If the fold is long and wide, the treatment of severe edge shoulder adduction contracture is performed with five trapezoid flaps: three of them are adipose-cutaneous prepared from the axillary fossa and healthy medial fold’s sheet; two others flaps are adipose-scar taken from the lateral scar sheet and FL surface for donor wound covering aside the axillary flap (Figure 7). After this three-flap plasty, the necessary number of flaps becomes obvious. Usually, the fold on all its extent is converted into trapezoid flaps and is counter transposed.
Figure 5g One year after surgery: excellent functional, good appearance, surface of flaps became significantly larger.

Figure 6 Severe right shoulder posterior edge contracture elimination and deformed scar excision on the shoulder and chest wall in a ten-year-old girl. (A and B) Pre-surgery view: severe adduction contracture, planning: borders of axillary trapezoid flap and scars excision.

Figure 6c Flap covered wound and compensated scar surface deficit, donor wound primarily closed; ten days after operation: flap alive contracture released, appearance significantly improved.

Severe posterior shoulder contracture treatment in children with trapezoid adipose cutaneous flap and skin transplants

Usually, the fold is moderate expressed; therefore, only one adipose-cutaneous flap is planned in axillary fossa (Figure 8 A,B). After a full contracture release with a Y-shaped incision from the fold crest to the joint rotation axis posteriorly, a large trapezoid wound appears, and scar surface deficit becomes obvious (Figure 8C). Trapezoid adipose-cutaneous flap covers central zone of fossa’s posterior edge and FL surfaced; flap also divides large wound on two: shoulder and thoracic. Severe scar surface deficit does not allow the scar sheet use for donor wounds covering because of the dissected scars’ divergence. Therefore, the wounds are split skin grafted. Shrinkage of skin transplants covering the wounds on shoulder and chest wall is minimal because the axillary fossa is stably suspended by the flap, which thus prevents contracture recurrence.

RESULTS OF OPERATIONS

The edge shoulder contractures were eliminated with trapezoid flaps in all 57 patients and fully shoulder abduction was achieved (Figure 2-8). In all cases, the reconstruction with trapezoid flaps was successful, as the sheets of the fold have sufficient new suitable plastic material for edge posterior contracture elimination. Adipose-cutaneous and adipose-scar trapezoid flaps were alive. No flap loss occurred. After reconstruction, stretching of the flaps and surrounding tissues gradually diminished as a result of skin growth; axillary fossa accepted normal shape (Figure 4D,5G). Hair-bearing skin was situated in axillary cupola. Follow-up results improve with...
time. The adipose-cutaneous flap stably suspended the axilla and posterior fossa’s edge and thus flap prevented contracture recurrence in all our patients and skin transplant shrinkage was minimal; stretched tissue rapidly grows after operation specially flaps from undamaged tissues.

**HIGHLIGHTS**

a. Shoulder edge posterior contracture is caused by scars covering the joint flexion lateral (FL)

b. Surface from the fold crest to the joint rotation axis.

c. Scars have surface insufficient (scar surface deficit) between shoulder and chest, causing

d. Contracture, trapezoid form, spreading from the crest wall to the joint rotation axis.

e. Form and size of scar surface deficit predetermine similar (trapezoid) flap preparation for

f. Completely scars surface deficit compensation and contracture elimination.

g. 4. Reconstruction consists in scar dissection with Y-incision and appearing trapezoid wound

h. covering (surface deficit compensation) with the adipose-cutaneous trapezoid flap, prepared

i. from all axillary fossa, and fold’s sheets

**DISCUSSION**

Based on review of literature and our clinical experience, the conclusion was made that two aspects of shoulder edge posterior adduction contractures are insufficiently researched: anatomy with classification and contracture cause or scar surface deficit which inhibits effective surgical treatment and averts the development of better techniques. Most authors assign the following names to specific contractures: linear, linear band, tight band, wide, wide linear, web, web straight linear, linear web, narrow, long, and cord like. These names indicate the surface form and spreading of scars, but not the contracture anatomic type.

Several numeric classifications are assigned to shoulder contractures complicating the matter. Kurtzman and Stern’s [2] introduced a III-type classification: Type IA- shoulder anterior; IB- shoulder posterior; Type II –anterior and posterior; Type III- wide scars cover joint including axillary fossa. Achauer [7] presented a IV-type classification. Ogawa R. et al. [8], classified axillary contractures into V types. Yang J-Y. [9] and Asuku et al. [10], pointed out that axillary contractures were characteristically divided into two groups: those involving the hairy dome and those that did not. Numeric classifications differ among themselves by different number of the same anatomic form. Consequently, the classification of scar contractures, based on anatomy, does not exist today. A classification based on the anatomy of multiple scar contractures had been previously published by the author; all contractures were classified into three types: edge, medial and total [3]. This classification is used in all our articles. Shoulder posterior contracture belongs to the edge type which has specific anatomo-clinical signs and is easily diagnosed.

**Skin grafting**

Yang [9] positively resorted to the use of skin grafts. Walash et al. [11], operated 25 patients. Type I contractures were reconstructed with skin transplants and Z-plasty; Z-plasty was suita ble for short linear band contractures; the five-flap technique was indicated in longer ones. For severe cases release and split skin graft was indicated. Dogra et al. [12], worked on a total of 100 cases of linear contractures that were managed by single or multiple Z-plasty techniques; whereas patients, having...
wider and dense scars, were managed by the release/excision of scars and covered by skin grafts. Karki et al. [13], operated 44 patients with axillary contractures, the posterior was in ten (22.72%). Surgical treatment included split thickness skin graft, propeller and square flaps.

Z-plasty

Chan and Donelan [4] indicated that Z-plasty had many uses in plastic surgery and was definitely a part of every plastic surgeon’s armamentarium; Z-plasty was used for treatment of shoulder scar edge contracture. Yung J-Y [9] noted that local Z-plasties could be enough for edge anterior axillary contracture release; for edge posterior contracture (“scar band deformity”) treatment, the author utilized a square flap. Duncan and Smith [14] considered that posterior axillary contracture had a solitary web and could be treated in the same way as its anterior counterpart (Z-plasty); the anterior axillary fold and hair-bearing cupola should not be disturbed; fascio-cutaneous flaps from the chest wall could be used. Exploring outcomes in children, Asuku et al. [10], found that all edge axillary contractures Type 1 were released complete.

Making Z-plasty more efficacious and safe, many modifications and combinations proposed. Yotsuyanagi et al. [15] reported that double combined Z-plasty was a very useful procedure for wide-scar contraction release, compared to conventional Z-plasty. Zhang et al. [16] described reversed Z-plasty and its variations to release wide-scar contraction. Combination of rhomboid flap and double Z-plasty technique for reconstruction of palmar and dorsal web space burn contractures presented by Sari et al. [17]. Hyashida and Akita S [18] developed surgical treatment algorithm for postburn contractures (rationale planning, incisions and tissue transposition). Since triangular flaps are used, results will be restricted.

V-Y Plasty

Suzuki et al. [19], write that this technique was one of the common techniques in plastic surgery and proposed a comprehensive classification of V-Y flaps and their analogs; flaps could be easily designed according to the degree of contracture and the shape of the scars and combining V-Y flaps with planimetric Z-plasties was found useful. The

V-Y plasty is rarely used for scar shoulder edge contractures treatment as flaps is not mobilized; therefore, its counter advancement restricted and contracture is released incomplete. Double opposing rectangular advancement flaps were proposed by Ertas and Borman [20], and the square flap method, by Hyakusoku et al. [21]. These flaps do not match the trapezoid scar surface deficit and the wound that appears after contracted scars dissection from posterior edge of fossa to the joint rotation axis. Not all authors observed only positive outcomes. Complete restoration of joint function often is not achievable with any of the currently used techniques. Simon-Williamson et al. [22], made analysis of upper extremity motion in children after axillary burn scar contracture release. Improvement Axillary contracture release surgery improves functional shoulder mobility and decreases compensatory motions were maintained for 1 year after surgery. Ten years after, authors [23] revealed that all shoulder movements with the exception of shoulder flexion during the high reach task and shoulder abduction during the hand to back task were not significantly different than normal values at long-term follow-up.

Hop et al. [6], reported that in 13.0% (n = 229/1768) of the patients with burns, reconstructive surgery was performed. Mean number of reconstructive procedure per patient were 3.6 (range 1-25). The most important indication was scar contracture; the most applied technique was release plus random flaps/skin grafting. Number of repeated operation indicates on two reasons: contracture was in complete released or after reconstruction followed serious complications. Huang and Ogawa [24] determined that Z-plasty was not possible in cases with limited availability of uninjured skin adjacent to the wound. Z-plasty is complicated with flap’s end necrosis; for preventing circulation insufficiency, Buis et al. [25], proposed two variants of sutures less stretching the flap’s end. Van Niekerk et al. [26], noticed that a success of V-Y plasty depended on the depth of the flap’s advancement only which was restricted as the flaps were not mobilized. Gumus [27] concluded that the V-Y technique used not mobilized flaps which could not close the defect completely; the deep incision through the fascia made the advancement of the V-flap easy by sliding. Balumuka et al. [5], reported that out of 58 patients with shoulder and elbow contractures, 30 (52 %) had a recurrence with 67% being shoulder contracture. The most commonly employed operative technique was the local triangular flaps. Complete release of the shoulder contracture was achieved in 56 % of right joint contractures and in 33 % of left joint contractures. Incomplete contracture release resulted in contracture recurrence.

Regional pedicle flaps are used for total and bilateral shoulder adduction contractures treatment. Lykoudis et al. [28], reported the use of latissimus dorsi flap with soft tissue expansion for shoulder edge posterior contracture treatment.

Stekelenburg et al. [29], explored the efficacy of scar contractures treatment with different techniques and concluded that no consensus regarding the type of the technique to use; no definite conclusions could be reached about the effectiveness of different techniques; therefore, no direct implication for daily practice could be made. At last, Klein [30-31] made conclusion that it is apparent that one should expect an evolution in surgical techniques and technologies that could improve the function and appearance of a person with burn injuries. No real evolution was observed regarding the scar contractures treatment. The literature analysis proves how complicated, intricate, and perplex the issue concerning the edge shoulder contracture elimination is. The local-flap techniques are based on the use of counter transposed symmetrical triangular flaps prepared from both fold’s sheets. Since fold’s sheets have different anatomic properties (one is scars, another is healthy skin), the counter transposed scar flaps penetrate dissected healthy skin, where there is not surface deficit; these scar flaps inside the healthy skin increase deformation. Triangular scar flaps do not match trapezoid wounds (shape of the scar surface deficit); triangular flaps could not be of necessary length (8-12 cm) because of necrosis.

Using this information, a conclusion was made that the
triangular-flap techniques were not suitable for shoulder contracture treatment. Other flaps (musculo-cutaneous, fascio-cutaneous pedicle, island, free flaps from neighboring and distant sites) can compensate surface deficit, cover the wound and contracture release, but the techniques are rather complex and the donor site damage becomes inevitable; flap can cause soft tissue excess.

The donor wounds aside the flap are covered by displacement of the lateral scar sheet to the flap; s base (Figure 2,3); more often the adipose-scar trapezoid flaps are prepared from the lateral scar sheet (Figure 4,5). The axillary adipose-cutaneous layer is extremely pliable and extensible. It has steady blood circulation. Axillary fossa can be significantly narrowed, and stretched skin of axillary fossa grows rapidly. The first attempt brought an impressive outcome, and in a short period of time reconstruction with axillary trapezoid flap became the technique of choice. The trapeze-flap plasty has an anatomic basis: the scar surface deficit has a trapezoid form; therefore, the trapezoid flap is most suitable for scar deficit compensation and contracture elimination. The axillary fossa is often uninjured and is located the closest to the reconstructed zone. The whole axillary area can be included in the flap without donor site damage.

CONCLUSION

New anatomical substantiation flaps and technique presented to edge shoulder posterior contracture elimination with axillary adipose-cutaneous trapezoid flap. The contracture is caused by the deficit of scars joint flexion lateral surface in length, from the shoulder to the chest wall; the scar surface deficit in width spreads from the fold’s crest, where it is maximal, to the joint rotation axis (8-12 cm in length or more). The wound length at the joint rotation level, between the joint FL and extension E surfaces is 4-6 cm and determines trapezoid form of the wound and car surface deficit which is real contracture cause. Such form and length of the flap is needed for scar surface deficit compensation and complete contracture elimination. Anatomically substantiated steps of the complete contracture release are as follows: (a) separation of contracted scars of FL surface from healthy skin with an incision along the fold’s crest (Cr); (b) then, the contracted scars of the flexion lateral surface are released, and their separation from the tissues of the joint extension surface is performed with a radial Y-shaped incision from the fold’s crest to the joint rotation axis. After shoulder abduction, a trapeze-shaped wound or scar surface deficit appears. Anatomical substantiation of scar surface deficit compensation and edge shoulder posterior contracture elimination: donor site – all axillary fossa and medial sheet of the fold to adequate trapezoid adipose-cutaneous flap elevation; this flap is transposed on the joint FL surface with tension, covers wound and complete compensates scar surface deficit; the trapezoid adipose-scar flaps from the lateral fold sheet cover the donor wounds aside the transposed flap. If the scar surface deficit is severe, a combined technique is used: the central wound’s zone is covered with a trapezoid adipose-cutaneous axillary flap which suspends posterior edge of axillary fossa and divides contracted scars and wound on thoracic wound/s aside the flap is skin grafted. Suspension of axilla and division of contracted scars with flap prevent the severe shrinkage of skin transplants and contracture recurrence. The proposed technique is easy to plan and perform. It is a simple and single-stage procedure that allows the surgeon to eliminate the contracture completely in pediatric and adult patients. In authors’ opinion, a single practical use of the trapeze-flap plasty will be sufficient for a reconstructive surgeon to accept it as a preferred method.

REFERENCES

18. Sari E, Tellioglu AT, Altuntas N, Seven E, Ozakpinar HR. Combination of rhomboid flap and double Z-plasty technique for reconstruction of palmar and dorsal web space burn contractures. Burns. 2015; 41: 10/11.