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# Compression Therapy after Complex Soft Tissue Trauma, and Flap Coverage: Optimization of Scar Development, Swelling, Function, and Aesthetic Result

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**Abstract**
Problems after severe soft tissue injuries, skin grafting, and flap procedures are uncontrolled hypertrophic scarring, unstable scars, functional deficits, and aesthetic disfigurements. Ongoing swelling and lymphatic stasis are also a common problem, and do contribute to functional problems. After deep skin / soft tissue injuries, an unstructured replacement tissue is formed (scar), and does not have all functions of healthy skin. After an initial increase of vascularisation in the scar region, the formation of unstructured collagen fibers takes place, spontaneously subsiding later with a shrinkage of the tissue. Compression therapy in these patients strongly enhances the reconstitution of form, and function. The consequence is a significant step forward in the rehabilitation of these patients, and earlier social as well as professional reintegration.

*Key words:* Scar development, hypertrophic scar, swelling, compression

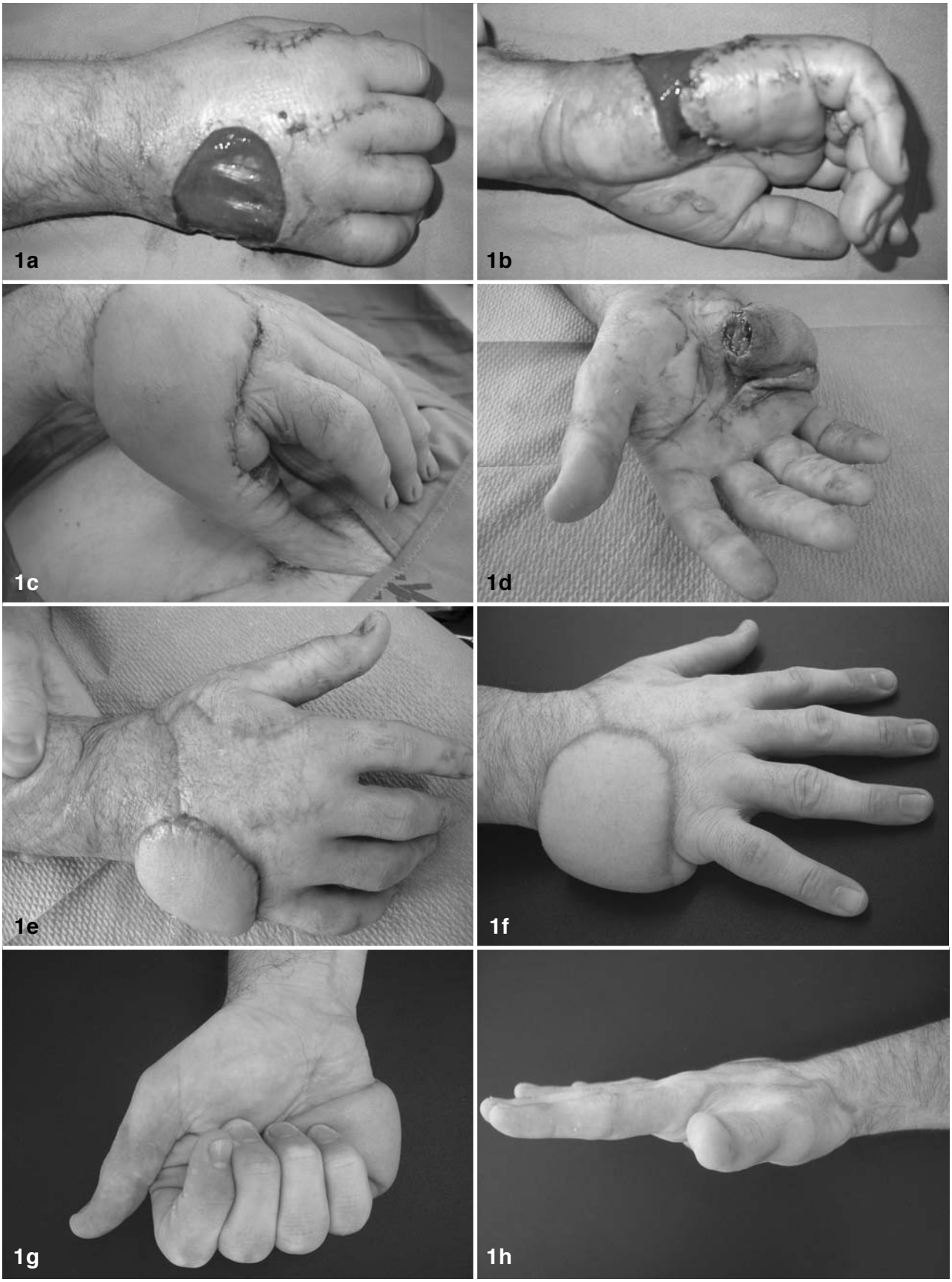
## Introduction

In the last decades the therapy of severe injuries to the integument made tremendous progress. The serious consequences of severe soft tissue injuries are uncontrolled hypertrophic scarring, unstable scars, functional deficits, infections, and aesthetic disfigurements. Ongoing swelling and lymphatic stasis are also a common problem, and do contribute to functional problems, most of all in the distal extremities. After deep skin / soft tissue injuries, an unstructured replacement tissue is formed (scar), and does not have all functions of healthy skin. After an initial increase of vascularisation in the scar region, the formation of unstructured collagen fibers takes place, spontaneously subsiding later with shrinkage of the tissue. First the scars are reddish, and normally get pale over the further course (9-18 months). Roughly 1 year later, the development of scars is not influenced with conservative techniques. We experienced clear advantages with the routine individual fitting of compression garments - which are regularly used in burn patients - with or without simultaneous silicone inlays [1-9].

## Discussion

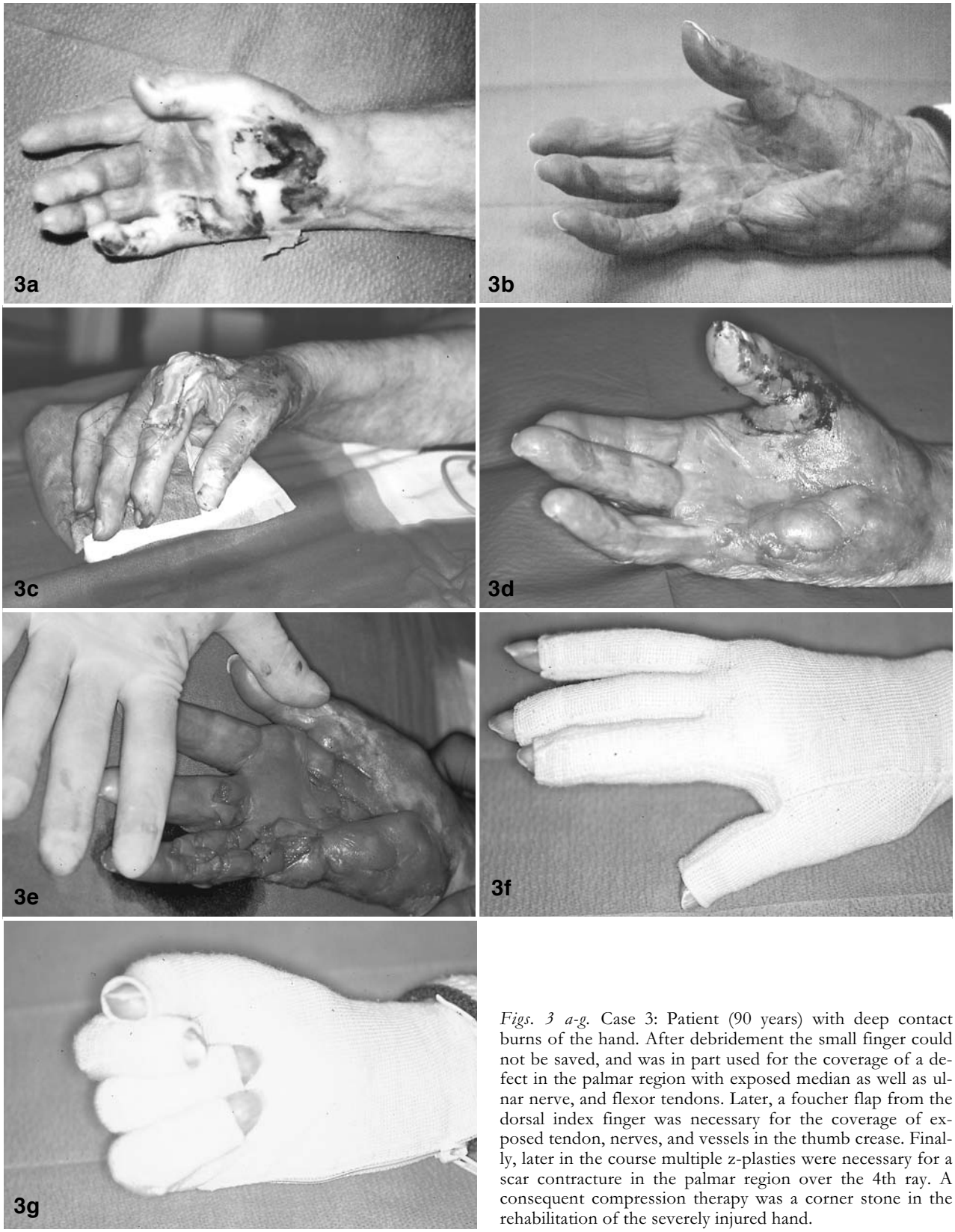
Compression therapy is not routinely indicated in regular healing wounds or burns with a healing time of approximately 14 days. In patients with a predisposition for inadequate scarring, swelling, all grafted wounds or after flap procedures, we early use compression therapy. While the exact mechanism for the positive effects of compression therapy is unclear, this form of treatment is a cornerstone in the adjunct therapy of burn patients after excision and grafting, and for us today after complex soft tissue trauma, and in difficult hypertrophic / keloid scars [1-5]. After an initial increase of vascularisation in the scar region, the increased formation of unstructured collagen fibers takes place. The lost physiologic continuous pressure of healthy skin, is replaced through individually fitted compression garments. The constant pressure on the injured soft tissues / skin may reduce the vascularisation, and the regeneration of skin coverage is superior regarding the contraction of the graft, structured formation of collagen fibers, and inflammatory reaction. Wound contraction and scarring is believed to be based on inadequate dermal regeneration, extensive re-modeling of the extracellular matrix, and differentiation of fibroblasts in myofibroblasts [11, 12]. The processes of cellular differentiation, dermal regeneration, synthesis, and re-modeling are regulated through cytokins, cell-cell-contacts and cell-matrix-interactions [13, 14]. Detailled data on these mechanisms, and interactions are yet missing. Possibly compression therapy reduces the migration or proliferation of myofibroblasts in the wound. The reduced migration of fibroblasts could positively influence the time scale, and intensity of wound healing.

The compression pressure must be higher than the capillary pressure of 24 mmHg. Newer investigations showed, that a compression pressure between 15 - 40 mmHg results in an enhanced maturation of the scar, and tapering of inadequate scarring [5]. The new formed skin coverage so becomes softer, more elastic, and supple. In the further course the reddening of the skin / scar subsides, and the color becomes more pale. In addition the adverse itching, probably related to the local hyperemia, is positively influenced.




*Figs. 1 a-j.* Case 1: Patient (29 years) with an almost circular decollement of the hand, and coverage of the defect with a groin flap. Under consequent compression therapy - with an individually fitted glove - the patient achieved a free function 2 months later, and acceptable contour.


*Figs. 2 a-d.* Case 2: Patient (65 years) with an unstable soft tissue coverage. Six weeks after replacement of the unstable scar zone with a microsurgical myocutaneous lattisimus dorsi flap the swelling, and contour did profit from early compression therapy.




*Figs. 3 a-g.* Case 3: Patient (90 years) with deep contact burns of the hand. After debridement the small finger could not be saved, and was in part used for the coverage of a defect in the palmar region with exposed median as well as ulnar nerve, and flexor tendons. Later, a foucher flap from the dorsal index finger was necessary for the coverage of exposed tendon, nerves, and vessels in the thumb crease. Finally, later in the course multiple z-plasties were necessary for a scar contracture in the palmar region over the 4th ray. A consequent compression therapy was a corner stone in the rehabilitation of the severely injured hand.

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The consequent postoperative compression therapy also has an impressing effect on swelling, and swelling related functional problems. The individual garments should be measured early, and temporary garments considered, until the definitive ones are manufactured.

Under continuous pressure the perfusion of the scar is reduced, and the activity of the scar is tapered down. Shortly after the compression garments are taken off, the reddening of the scars, and swelling become prominent again. The optimal aim should be to wear the garments day and night, while in the beginning the use of the garments for hours is acceptable. For hygienic reasons, a second pair of garments should be available. The garments should be applied over a course of 6 to 18 months, depending on the maturity of the scar. Nevertheless, in children this period of time can be prolonged. Compression therapy highly depends on cooperation, and understanding of the patient, or in children of the parents, and family. The compliance of the individual persons is directly depending on the wearing comfort of the garments. The variety of colors available has an advantageous attractive effect, especially in children. After dismissal from the hospital a close follow up by an experienced surgeons is warranted, to re-evaluate the development of the scar, or early treat therapy resistant scarring with a plastic surgical procedure.

The anatomic relations in the face make the use of compression garments difficult. Improvements or supplementation of compression therapy are possible through the additional application of silicone. Silicone is available in different modifications, and can be chosen on the individual scar basis [6-9]. For concavities silicone inlays can be individually produced, and formed on the scar. An other form of silicone are sheets, available in a variety of sizes, and thicknesses, which are cut on the related size of the scar. Frequently, we use silicone garments for individual fingers or gloves or a firm mask with a silicone inlay for the face as an alternative or supplementation to a compression face mask [10]. For smaller size scars of the face a silicone cream applied twice a day can be an alternative treatment. Traditionally the use of topical silicone is first indicated after wound closure, in order to prevent potential reactions or infections. In some patients even allergic reactions to silicone do occur, and are treated by a change to another product, but mostly silicone can not be continued in these patients. The mode of action of silicone is not finally investigated, but there is no evidence that silicone particles are systemically absorbed. A variety of mechanisms, i.e. a chemical effect, hydration, and occlusion are discussed [6-9]. Clearly clinically visible is the enhanced sweating underneath the silicone sheet. After removal of the silicone the skin is softer and more elastic, the reddening and swelling go downward. Since the silicone is applied for roughly 12 hours (during the night) the combination with a compression garment makes sense.

A serious trauma - with a soft tissue defect, difficult wound closure or even complex plastic surgical reconstruction - means an enormous cut in the daily living of patients. Due to the change of the exterior appearance, health problems, and frequent additional family, profession, and financial problems a psychological support should be considered. After dismissal from the hospital this chapter in the patients life is not finished. The daily routine is centered on scar care, and treatment, physical therapy, lymph drainage, and ambulatory visits of various physicians. On the long run, frequently secondary plastic surgical procedures for the improvement of form and function become necessary. Compression therapy in these patients strongly enhances the reconstitution of form, and function. The consequence is a significant step forward in the rehabilitation of these patients, and earlier social as well as professional reintegration.

## Literature


1. Garcia-Velasco M, Ley R, Mutch D, Surkes N, Williams HB (1978) Compression treatment of hypertrophic scars in burned children. Can J Surg 21:450-2
2. Kloti J, Pochon JP (1979) Long-term therapy of second and third degree burns in children using Jobst-compression suits. Scand J Plast Reconstr Surg 13:163-6
3. Rose MP, Deitch EA (1985) The clinical use of a tubular compression bandage, Tubigrip, for burn-scar therapy: a critical analysis. Burns Incl Therm Inj 12:58-64
4. Reid WH, Evans JH, Naismith RS, Sherwin S (1987) Hypertrophic scar and pressure therapy. Burns 13: 529-32
5. Robson MC, Barnett RA, Leitch IO, Hayward PG (1992) Prevention and treatment of postburn scars and contracture. World J Surg 16:87-96
6. Perkins K, Davey RB, Wallis KA (1983) Silicongel: a new treatment for burn scars and contractures. Burns Incl Therm Inj 9:201-4
7. Quinn KJ (1987) Silicone gel in scar treatment. Burns 13:33-40
8. Ahn ST, Monafo WW, Mustoe TA (1989) Topical silicone gel: a new treatment for hypertrophic scars. Surgery.;106: 781-6; discussion 786-7
9. Fulton JE Jr (1995) Silicone gel sheeting for the prevention and management of evolving hypertrophic and keloid scars. Dermatol Surg 21:947-51
10. Le Coultre C, Graber A (1985) The use of plastic face mask and silicone gloves and boots as alternative to compression suits for treating hypertrophic scars. Z Kinderchir 40:221-3
11. Gabbiani G, Ryan GB, Majno G (1971) Presence of modified fibroblasts in granulation tissue and possible role of wound contraction. Experientia 27:549-550
12. Desmouliere A, Geinoz A, Gabbiani F, Gabbiani G (1993) Transforming growth factor beta 1 induces alpha-smooth muscle activation actin expression in granulation tissue myofibroblasts and is quiescent and growing cultured fibroblasts. J Cell Biol 122:103-11
13. Tooney PA, Agrez MV, Burns GF (1993) A re-examination of the molecular basis of cell movement. Immunol Cell Biol 71:131-39
14. Grinnell F (1994) Fibroblasts, myofibroblasts, and wound contraction. J cell Biol 124: 401-4


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