Scalp reconstruction by tissue expansion: tips and tricks

Giorgio Raposio¹, Edoardo Raposio¹,²
¹Plastic Surgery Chair, Department of Surgical Sciences and Integrated Diagnostics (DISC), University of Genova, Italy; ²Plastic and Reconstructive Surgery Division, IRCCS Policlinico San Martino, Genova, Italy

Abstract. Background and aim: Numerous details regarding preoperative planning of scalp expansion are of the utmost importance for maximizing the results of this procedure. Methods: The purpose of this paper is to describe the tips and tricks useful for obtaining the best results in scalp expansion. Results: Basic concepts and operative technique are discussed and detailed. Conclusions: In scalp reconstruction, the use of tissue expansion allows to obtain successful results, Anyhow, it is mandatory to follow some basic rules, dictated by anatomical, technical, and psychological considerations. (www.actabiomedica.it)

Key words: Scalp defects, scalp reconstruction, tissue expansion.

Introduction

The procedure of tissue expansion has an extremely important role in the reconstructive surgery armamentarium. Tissue expansion allows to reconstruct even large cutaneous defects with an optimal matching of donor tissue to recipient site. Moreover, flaps obtained by tissue expansion are usually innervated and well vascularized (1-29). Anyhow, the scalp has peculiar anatomical characteristics that affects its expansion, as the presence of hairs and galea aponeurotica (30-52). Particularly in this regard, some details regarding preoperative planning of tissue expansion are of the utmost importance for obtaining a successful result, the more important of them will be detailed hereinafter.

Surgical technique

We may identify anatomical, technical, and psychological considerations, all equally important.

Anatomical considerations

Galea aponeurotica (or galea capitis) is a tendon-like structure between the pericranium and the subcutaneous adipose tissue. The first point to underline is that a tissue expander in the scalp has always to be positioned under the galea aponeurotica. This is because the vascularization of the scalp is intimately connected with galeal upper surface. Trying to undermine the galea from above would lead to a deleterious loss of vascularization of the scalp.

If we place a tissue expander under the galea, its anelastic behavior will delay the process of scalp expansion. To obtain an equal volume of filling, a 50% more of time is usually requested when comparing scalp expansion to other body regions.

Another distinctive feature of the scalp is the presence of hair bulbs. A significant percentage of male patients will experience androgenetic alopecia of various degrees during their lifetime. Since occipital hair bulbs are usually not affected by male-pattern baldness, in terms of hair coverage, the occipital regions are to be preferred when positioning an expander in a male patient.

Technical considerations

Unlike semi-spherical or crescent expanders, rectangular ones allow to develop the maximum projection along the entire support base. Bearing this
fundamental point in mind, it is always better to prefer rectangular tissue expanders (Fig. 1), optimizing results of scalp expansion. For the same reason, when using a rectangular tissue expander, it is always mandatory to place it with its longer and narrower face as a base (Fig. 2).

Fig. 1. Rectangular tissue expander.

A

B

Fig. 2. a) Tissue gain (1x) obtained with horizontal placement of the expander, b) tissue gain (4x) obtained with vertical positioning of the expander.
This will allow to quadruplicate the projection and, consequently, tissue gain.

Psychological considerations

As described above, scalp expansion is a long process, being its mean duration usually more than three months. During this period, and particularly at the end of the expansion, the patient must face a socially important deformity. It is of the utmost importance to accurately detail this point during the initial consultation. Some patients may underestimate this factor, leading to a failure of the procedure with the patient asking for premature expander’s removal.

Conclusions

In scalp reconstruction, the use of tissue expansion allows to obtain successful results (Fig. 3).

Fig. 3. Extensive scalp scar resulting from burn, a) lateral view, b) frontal view; c) at the end of a three-month expansion period (rectangular expander placed in a vertical position); d) post-operative results. Anyhow, it is mandatory to follow some basic rules, dictated by anatomical and technical considerations, for optimizing results and avoid complications.
Conflict of Interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

Informed Consent: Written informed consent was obtained from the patient concerned.

References

1. Swanson NA, Argenta LC. Tissue expansion. Adv Dermatol. 1988;3:243-58.
2. Madison JB. Tissue expansion. Vet Clin North Am Equine Pract. 1989 Dec;5(3):633-42.
3. Bjornson LA, Bucejvska M, Verchere C. Tissue expansion in pediatric patients: a 10-year review. J Pediatr Surg. 2019 Jul;54(7):1471-1476.
4. Asa’ad F, Rasperini G, Pagni G, Rios HF, Gianni AB. Pre-augmentation soft tissue expansion: an overview. Clin Oral Implants Res. 2016 May;27(5):505-22.
5. Collins SA, Swanson NA. Chronic tissue expansion. J Dermatol Surg Oncol. 1993 Dec;19(12):1090-8.
6. Krieger Y, Silberstein E, Shoham Y, Bogdanov-Berezovsky A. Tissue Expansion: Still Not Expendable. Isr Med Assoc J. 2017 Feb;19(2):119-120.
7. Malata CM, Williams NW, Sharpe DT. Tissue expansion: an overview. J Wound Care. 1995 Jan;4(1):37-44.
8. Marcus J, Horan DB, Robinson JK. Tissue expansion: past, present, and future. J Am Acad Dermatol. 1990 Nov;23(5 Pt 1):813-25.
9. Rivera R, LoGiudice J, Gosain AK. Tissue expansion in pediatric patients. Clin Plast Surg. 2005 Jan;32(1):35-44, viii.
10. Teo I, Cairns S, Stephenson AJ. Reverse tissue expansion. Ann R Coll Surg Engl. 2014 Apr;96(3):239.
11. Hoffmann JF. Tissue expansion in the head and neck. Facial Plast Surg Clin North Am. 2005 May;13(2):315-24, vii.
12. Lee T, Vaca EE, Ledwon JK, Bae H, Topczewska JM, Turin SY, Kuhl E, Gosain AK, Tepole AB. Improving tissue expansion protocols through computational modeling. J Mech Behav Biomed Mater. 2018 Jun;82:224-234.
13. Janes LE, Ledwon JK, Vaca EE, Turin SY, Lee T, Tepole AB, Bae H, Gosain AK. Modeling Tissue Expansion with Isogeometric Analysis: Skin Growth and Tissue Level Changes in the Porcine Model. Plast Reconstr Surg. 2020 Oct;146(4):792-798.
14. Siegert R, Weerda H. Die Hautexpansion. Teil 1: Technische und physiologische Grundlagen [Tissue expansion. Part 1: Technical and physiologic principles]. HNO. 1994 Feb;42(2):124-37.
15. Johnson TM, Lowe L, Brown MD, Sullivan MJ, Nelson BR. Histology and physiology of tissue expansion. J Dermatol Surg Oncol. 1993 Dec;19(12):1074-8.
16. Raposio E, Santi P. Computer-aided preoperative planning of tissue expansion. Ann Plast Surg. 1997 Oct;39(4):416-7.
17. Raposio E, Santi P. Computer planning for breast reconstruction by tissue expansion. Plast Reconstr Surg. 1998 Jun;101(1):1931-3.
18. Raposio E, Panarese P, Cella A, Gualdi A, Faggioni M, Renzi M, Caregnato P, Santi PL. Effects of topical pharmacologic therapy in cutaneous expansion in reconstructive surgery. Chirurgia. 1999; 12(6): 465-7.
19. Raposio E, Cella A, Panarese P, Caregnato P, Gualdi A, Santi PL. Quantitative benefits provided by acute tissue expansion: A biomechanical study in human cadavers. Br J Plast Surg. 2000 Apr;53(3):220-4.
20. Raposio E, Cella A, Caregnato P, Distefano A, Gualdi A, Ricci M, Capello C, Santi PL. Computer-aided preoperative planning of tissue expansion. Minerva Chir. 2001 Oct;56(5):543-5.
21. Raposio E, Bertozzi N. Quantitative difference of acute intraoperative expansion in various body regions. Eur Rev Med Pharmacol Sci. 2017;21:454-9.
22. Raposio E, Bertozzi N. Ultrastructural effects of topical dimethyl sulfoxide on collagen fibers during acute skin expansion in a human ex-vivo model. Eur J Plast Surg. 2017; 40(4): 271-6.
23. Raposio E, Santi PL. Topical application of DMSO as an adjunct to tissue expansion for breast reconstruction. Br J Plast Surg. 1999 Apr;52(3):194-7.
24. Raposio E, Cella A, Renzi M, Caregnato P, Barabino P, Faggioni M, Gualdi A, Santi PL. Clinical evaluation of a new adjuvant pharmacological protocol in breast reconstruction by tissue expansion. Chirurgia. 1999; 12(3): 237-9.
25. Raposio E, Caregnato P, Distefano A, Capello C, Santi PL. Computer planning for postmastectomy breast reconstruction by tissue expansion. Minerva Chir. 2001 Apr;56(2):205-8.
26. Raposio E, Caregnato P, Barabino P, Gualdi A, Oreifice A, Spagnolo A, Capello C, Santi PL. Computer-based preoperative planning for breast reconstruction in the woman with unilateral breast hypoplasia. Minerva Chir. 2002 Oct;57(5):711-4.
27. Raposio E, Cicchetti S, Adami M, Ciliberti RG, Santi PL. Computer planning for breast reconstruction by tissue expansion: An update. Plast Reconstr Surg. 2004 Jun;113(7):2095-7.
28. Bertozzi N, Pesce M, Santi P, Raposio E. Tissue expansion for breast reconstruction: Methods and techniques. Ann Med Surg (Lond). 2017 Jul;21:23-44.
29. Bellini E, Pesce M, Santi P, Raposio E. Two-Stage Tissue-Expander Breast Reconstruction: A Focus on the Surgical Technique. Biomed Res Int. 2017 Volume 2017, Article ID 1791546, 1-8.
30. Desai SC, Sand JP, Sharon JD, Branham G, Nussenbaum B. Scalp reconstruction: an algorithmic approach and systematic review. JAMA Facial Plast Surg. 2015 Jan-Feb;17(1):56-66.
31. Dedhia R, Luu Q. Scalp reconstruction. Curr Opin Otolaryngol Head Neck Surg. 2015 Oct;23(5):407-14.
32. Laitung JK, Brough MD, Orton CI. Scalp expansion flaps. Br J Plast Surg. 1986 Oct;39(4):542-8. doi: 10.1016/0007-1226(86)90132-3.
33. Dinis J, Junn A, Kahle K, Alperovich M. Extended Scalp Expansion for Larger Defects During Staged Cranioplasty. J Craniofac Surg. 2022 May 1;33(3):787-789.
34. Cooper JB, Kim MG, Mohan A, Tobias ME. Decompressive craniectomy with scalp expansion graft using a temporary synthetic skin substitute in the pediatric population: case series and review of the literature. Childs Nerv Syst. 2020 Jun;36(6):1319-1324. doi: 10.1007/s00381-019-04494-5.
35. Bradford BD, Lee JW. Reconstruction of the Forehead and Scalp. Facial Plast Surg Clin North Am. 2019 Feb;27(1):85-94.
36. Dong W, Wang H, Fan F. Scalp expansion for giant cutis verticis gyrata secondary to cerebriform intradermal nevus. J Int Med Res. 2020 Dec;48(12):300060520974243.
37. Brodsky MA, Rezac L, Terella A, Brown M. Tissue Expansion Before Mohs Micrographic Surgery for a Large Scalp Tumor. Dermatol Surg. 2021 Jul 1;47(7):997-998.
38. Funakoshi Y, Shono T, Kurogi A, Machara N, Hata N, Mizoguchi M. Intraoperative Tissue Expansion Using a Foley Catheter for a Scalp Defect: Technical Note. World Neurosurg. 2020 Nov;143:62-67.
39. Kim J. Treatment of Scalp Scars. Facial Plast Surg Clin North Am. 2017 Feb;25(1):83-88
40. Fowler NM, Futran ND. Achievements in scalp reconstruction. Curr Opin Otolaryngol Head Neck Surg. 2014 Apr;22(2):127-30.
41. Frechet P. Scalp extension. J Dermatol Surg Oncol. 1993 Jul;19(7):616-22.
42. Azzi JL, Thabet C, Azzi AJ, Gilardino MS. Complications of tissue expansion in the head and neck. Head Neck. 2020 Apr;42(4):747-762.
43. Earnest LM, Byrne PJ. Scalp reconstruction. Facial Plast Surg Clin North Am. 2005 May;13(2):345-53, vii.
44. Raposio E, Adami M, Capello C, Ferrando G, Molinari R, Renzi M, Caregnato P, Gualdi A, Faggioni M, Panarese P, Santi PL. Intraoperative expansion of scalp flaps. Quantitative assessment. Minerva Chir. 2000 Sep;55(9):629-34.
45. Raposio E, Cella A, Barabino P, Santi P. Ineffectiveness of acute scalp expansion. Plast Reconstr Surg. 1999 May;103(6):1645-9.
46. Raposio E, Nordström RE, Santi PL. Undermining of the scalp: quantitative effects. Plast Reconstr Surg. 1998 Apr;101(5):1218-22.
47. Raposio E, Nordström RE. Biomechanical properties of scalp flaps and their correlations to reconstructive and aesthetic surgery procedures. Skin Res Technol. 1998 May;4(2):94-8.
48. Nordström RE, Raposio E. Scalp extension—a quantitative study. Dermatol Surg. 1999 Jan;25(1):30-3.
49. Raposio E, Santi PL, Nordström RE. Serial scalp reductions: a biomechanical approach. Dermatol Surg. 1999 Mar;25(3):210-4.
50. Lago G, Raposio E. Reconstructive options in scalp surgery. Chirurgia 2020 Apr;33(2):93-9.
51. Spinzo G, Raposio E. Reconstructive surgery of the scalp: Indications and techniques. Chirurgia. 2020;33(5):249-54.
52. Raposio E, Nordström RE. Tension and flap advancement in the human scalp. Ann Plast Surg. 1997 Jul;39(1):20-3.