RESEARCH PAPER

A Systematic Review On Soft Tissue Expanders For Intraoral Soft Tissue Augmentation

Prasanna Kumar P S[1], Dhanraj Ganapathy[1*], Keerthi Sasanka Lakkoji[1], Rajalakshmanan Eswaramoorthy[1]

[1] Department of Prosthodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Chennai, India.

[*] Corresponding Author: Dhanraj Ganapathy. Email: dhanraj@saveetha.com

ABSTRACT

Background

Intraoral soft tissue augmentation is a critical component of dental and maxillofacial reconstructive procedures, playing a vital role in achieving optimal aesthetic and functional outcomes.

Aim

This systematic review aims to synthesize the current evidence on the effectiveness of soft tissue expanders for intraoral soft tissue augmentation.

Materials and Methods

Search Strategy: ("soft tissue expanders" OR "tissue expanders") AND ("soft tissue augmentation" OR "tissue augmentation") AND ("clinical outcomes" OR "volume gain" OR "effectiveness"). **Methodology:** A structured search strategy was implemented across several electronic databases, including PubMed, Embase, Web of Science, Scopus, and the Cochrane Library, chosen to encompass a broad array of biomedical and dental research. The eligibility criteria for included manuscripts were rigorously defined to ensure the selection of relevant, high-quality studies. Studies involving human participants undergoing intraoral soft tissue augmentation with soft tissue expanders were prioritized, with a requirement for a control or comparison group to evaluate effectiveness. Relevant primary outcomes included changes in soft tissue volume, bone gain, complications, and patient-reported outcomes. A PICO framework was developed to guide the literature retrieval process, ensuring a comprehensive identification of studies related to intraoral soft tissue augmentation techniques.

Data Collection and Analysis

Data extraction from the included articles was done by two authors independently and then combined together. Data characteristics were extracted using data collection forms whereas the quality of the study was assessed by using RoB tools.

Results

The keyword search using the PICO framework identified 32 potentially relevant manuscripts for the systematic review on soft tissue expanders for intraoral soft tissue augmentation. After screening titles and abstracts, 20 studies were excluded for irrelevance or misalignment with key topics. This left 12 studies for detailed evaluation, where an additional 6 were excluded for not meeting the inclusion criteria, such as focusing solely on other augmentation techniques. Ultimately, six studies were selected for final analysis, representing the best available evidence on the effectiveness and outcomes of soft tissue expanders.

Conclusion

This systematic review concludes that the use of soft tissue expanders, particularly self-inflating hydrogel models, significantly enhances both vertical and horizontal bone augmentation in GBR procedures. The expanders provide not only hard tissue benefits but also contribute to improved soft tissue outcomes, such as soft tissue thickness and stability, which are crucial for long-term implant success.

Keywords: Augmentation, Bone Gain, Complications, Intraoral, Soft Tissue expander, Vertical and horizontal expansion

How to cite this article: Prasanna Kumar P S, Ganapathy D, Lakkoji K S, Eswaramoorthy R. A systematic review on soft tissue expanders for intraoral soft tissue augmentation. Int J Drug Deliv Technol. 2026;16(37s): 730-736. DOI: 10.25258/ijddt.16.37s.93

Source of support: Nil.

Conflict of interest: None

Introduction:

Intraoral soft tissue augmentation is essential for achieving optimal aesthetic and functional outcomes in dental and maxillofacial reconstruction. Patients with inadequate soft tissue due to congenital anomalies, trauma, periodontal disease, or previous surgeries often experience compromised implant success and esthetics (Somodi et al., 2024; Zhang et al., 2024). Insufficient soft tissue may lead to complications such as graft exposure, infection, and implant failure, highlighting the need for adequate tissue volume prior to surgical intervention (Selvaprithiviraj et al., 2023).

Conventional augmentation methods, including autografts, allografts, and xenografts, remain effective but are associated with limitations such as donor site morbidity, limited availability, and unpredictable healing outcomes (Tavelli et al., 2023). To address these issues, soft tissue expanders have emerged as a minimally invasive alternative that promotes gradual tissue formation through controlled expansion (Herford et al., 2019). This technique improves soft tissue volume, vascularity, and quality, creating a favorable environment for implant placement and enhanced esthetic outcomes. Clinical evidence suggests that pre-implant tissue expansion increases soft tissue thickness, reduces complications, and improves long-term implant stability (Mertens et al., 2015; Strauss et al., 2024).

Despite increasing clinical use, the efficacy and safety of soft tissue expanders remain inconsistent due to heterogeneity in study designs and outcome measures (Garner et al., 2019; Rojo et al., 2018). Therefore, this systematic review aims to critically evaluate existing evidence on their effectiveness, focusing on clinical outcomes such as tissue thickness, complication rates, and patient satisfaction.

MATERIALS AND METHODS

PROTOCOL AND REGISTRATION

For this study, we followed the guidelines given by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Guidelines (PRISMA) and was based on the protocol that we set, which defined the search strategy, study selection, data extraction and analysis methods.

SEARCH STRATEGY

A comprehensive literature search of the following databases were done which included studies of the Pubmed, Pubmed central, Medline, Cochrane database of systematic reviews, Mesh, Science direct, Embase databases. Articles were selected based on the selection criteria.

Study selection

Studies were independently screened by two reviewers, and any discrepancies were resolved through discussion within the search group. The following inclusion criteria were applied: (1) studies reporting on the use of soft tissue expanders for intraoral soft tissue augmentation, including both clinical and preclinical evaluations; (2) clinical trials and observational studies assessing outcomes related to soft tissue volume gain, patient satisfaction, and complications; (3) full-text articles published in English; and (4) studies published within the last 20 years (2004–2024) to ensure relevance to current clinical practice.

The exclusion criteria were: (1) studies not specifically focused on soft tissue expanders for intraoral augmentation; (2) articles lacking original data, such as reviews, editorials, letters, and conference abstracts; (3) studies providing insufficient methodological or outcome-related details; (4) non-English publications; and (5) studies published before 2004.

The eligibility criteria for manuscripts included in this systematic review were carefully defined to ensure the inclusion of relevant and high-quality evidence. Only peer-reviewed articles, including randomized controlled trials, prospective cohort studies, retrospective studies, and case series, were considered. Reviews, editorials, and commentaries were excluded. All selected studies involved human participants undergoing intraoral soft tissue augmentation using soft tissue expanders, thereby excluding animal studies and investigations focused on unrelated surgical techniques.

Eligible studies examined the use of soft tissue expanders either alone or in combination with grafting materials. Each study included a control or comparison group, consisting of patients treated with conventional techniques without expanders or with alternative expander systems, allowing for meaningful evaluation of effectiveness. The primary outcomes assessed were changes in soft tissue volume, bone gain, complications associated with expander use, and patient-reported outcomes such as pain and satisfaction. Secondary outcomes included histological findings, soft tissue thickness, and long-term tissue stability.

A minimum follow-up period of three months was required for inclusion to ensure adequate assessment of early healing and treatment outcomes. Only English-language articles were included to avoid

potential translation inaccuracies. Studies published from 2000 to the present were considered to capture recent advancements in soft tissue augmentation techniques.

By adhering to these predefined criteria, this systematic review aimed to provide a rigorous and comprehensive evaluation of the efficacy and safety of soft tissue expanders for intraoral applications, thereby contributing meaningful evidence to the existing literature.

INFORMATION SOURCES

SELECTION PROCESS

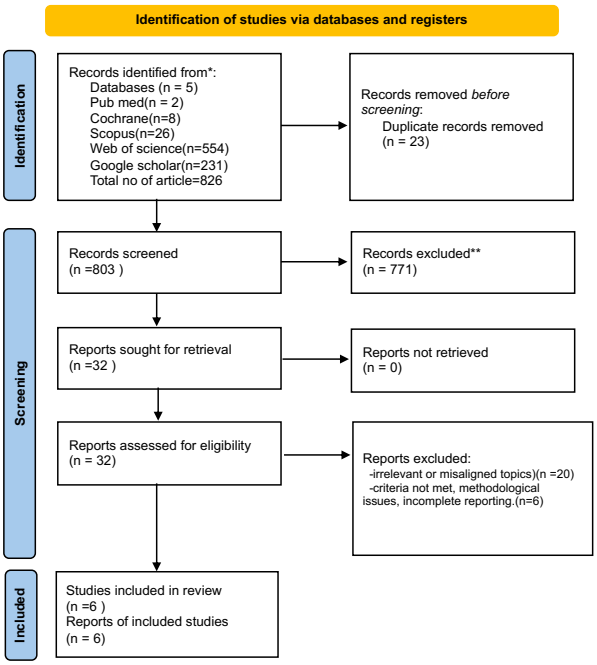
The study selection process involved a systematic screening of the titles and abstracts of all retrieved studies, conducted independently by two reviewers. Any studies deemed potentially relevant underwent a subsequent evaluation, during which full-text articles were retrieved and assessed for eligibility according to predefined inclusion and exclusion criteria.

DATA EXTRACTION

A standardized data extraction form was employed to systematically gather essential information from the included studies. Key data collected encompassed study design, population characteristics (including animal models and human subjects), types of soft tissue expanders utilized, techniques of soft tissue augmentation, outcome measures related to soft tissue gain and complication rates, and comparisons to conventional techniques. This thorough data extraction process ensured comprehensive analysis and synthesis of the evidence regarding the effectiveness and safety of soft tissue expanders for intraoral soft tissue augmentation**.**

QUALITY ASSESSMENT AND LEVEL OF EVIDENCE

The level of evidence of each of the included studies was also assessed according to the Oxford Centre for Evidence -Based medicine, 2009. (OXFORD CENTRE FOR EVIDENCE- BASED MEDICINE – LEVELS OF EVIDENCE).



Characteristics of included studies

Author (Year)	Study Type	Groups	Patients (n)	Intervention	Primary Outcomes	Secondary Outcomes	Duration	Results	Complications	Key Findings
Byun, Kim, Lee et al. (2020)	Prospective, multicenter randomized controlled trial	Experimental: Tissue expander + tunneling bone graft	46 (23 in each group)	Subperiosteal tissue expander vs. conventional vertical GBR	Vertical bone gain, tissue expansion	Soft tissue thickness, complications	4 weeks	Exp group: 5.12 ± 1.25 mm vertical gain ($p < 0.05$); Control: 4.22 ± 1.15 mm	Over-expansion (2 cases), mucosal perforation (1 case)	Tissue expanders significantly improved vertical bone gain and reduced bone loss compared to conventional GBR
Ali et al. (2023)	Prospective randomized controlled trial	Test: Soft tissue expander + autogenous bone block	16 (8 in each group)	Soft tissue expander prior to horizontal alveolar ridge augmentation	Bone width, histomorphometry	Quality of augmented bone, mature collagen, blood vessel count	6 months	Group I: Bone width 8.57 mm, Group II: 8.75 mm ($p > 0.05$); Group I had better bone quality	Perforation in one expander due to pouch tightness, infections in some patients	Although bone width was comparable, Group I showed superior bone quality and vascularization
Tawfik et al. (2023)	Prospective randomized controlled trial	Group I: Expander + bone graft; Group II: Bone graft only	24	Expander + bone graft vs. bone graft alone	Grafted bone volume, soft tissue profile	Stability of soft tissue (lower lip, labiomental sulcus)	6 and 24 months	Group I had superior bone volume gain (1.95 cm^3, $p = 0.05$); Better soft tissue profile	Infection in 1 case, hematomas in 2 cases	Tissue expander resulted in significantly higher bone volume and better soft tissue outcomes

Abrahamsson et al. (2012)	Prospective study	Group A: Self-inflating soft tissue expander + bone graft; Group B: Mandibular ramus bone block graft	20	Self-inflating tissue expander vs. ramus bone block	Soft tissue profile change, vertical and lateral bone augmentation	Bone resorption, complications	Implant placement	Soft tissue profile: 2.9 ± 1.1 mm (Group A) vs. 1.5 ± 1.4 mm (Group B); Vertical bone augmentation: 3.0 mm (Group A) vs. 1.6 mm (Group B)	Soft tissue perforations in 2 patients in experimental group	Tissue expanders showed better vertical and lateral bone augmentation than conventional bone grafting, with less resorption. Smokers had higher resorption rates.
Shomurodov et al. (2023)	Prospective randomized controlled trial	Group A: Hydrogel soft tissue expander + GBR; Group B: Autograft; Group C: Xenograft; Group D: Combi-graft	76	Soft tissue expander + GBR vs. autograft, xenograft, combi-graft	Horizontal and vertical bone gain, microcirculation	Complications, stability of dental implants	6 months	Horizontal bone gain: 4.4 mm (Exp group); Vertical bone gain: 4.07 mm; Higher implant stability in experimental group	None mentioned	Soft tissue expander combined with GBR showed significant improvements in bone gain and dental implant stability, with positive influence on microcirculation.

RESULTS:

The keyword search with PICO yielded 32 manuscripts potentially relevant to the systematic review on soft tissue expanders for intraoral soft tissue augmentation. A multi-step screening approach was adopted to refine the selection process.

Keyword Search and Screening Process:

The initial keyword search identified 32 potential titles relevant to the systematic review on soft tissue expanders for intraoral soft tissue augmentation. These studies covered a variety of topics within the field of soft tissue expansion techniques. However, to focus on the most pertinent literature, the titles and abstracts of these studies were screened, leading to the exclusion of 20 studies. These exclusions were based on irrelevance or a lack of alignment with the key topics of the review (such as concentrating on unrelated technologies, surgical techniques, or outcomes).

After this first round of screening, 12 studies remained for more detailed evaluation. These studies were subjected to an in-depth review, where the exclusion criteria were rigorously applied. At this stage, 6 additional studies were excluded because they either did not meet the criteria (e.g., focusing solely on other augmentation techniques or lacking sufficient data on soft tissue expansion). Some studies have been excluded for methodological reasons or incomplete data reporting, further ensuring that only high-quality studies were selected.

Final Selection:

Ultimately, six studies were found to meet all the inclusion criteria and were included in the final analysis. These studies represent the best available evidence on the use of soft tissue expanders for intraoral soft tissue augmentation and provide valuable insights into their effectiveness and outcomes. By focusing on this select group of studies, the systematic review ensures that the conclusions drawn are based on high-quality, relevant, and recent research, enhancing the understanding of soft tissue expanders in dental and oral surgery, as illustrated in the PRISMA flow chart(Fig 1).

Risk of Bias Assessment:

The risk of bias for each included study in this systematic review was assessed using the Cochrane Risk of Bias Tool, which evaluates domains such as selection, performance, detection, attrition, reporting, and other potential biases. To ensure objectivity, two independent reviewers conducted the assessments.

For randomized controlled trials, the following domains were examined: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessors, incomplete outcome data, and selective reporting. Studies were categorized as having a low, high, or unclear risk of bias based on reporting clarity and methodological rigor.

For non-randomized studies, the ROBINS-I tool was applied, assessing confounding, participant selection, intervention classification, deviations from intended interventions, missing data, outcome measurement, and selective reporting.

Any disagreements between reviewers were resolved through discussion or consultation with a third reviewer. This rigorous process enhanced the transparency, validity, and reliability of the findings in this systematic review.

DISCUSSION:

The use of soft tissue expanders and polymer-based scaffolds, such as hydrogels, for intraoral soft tissue augmentation has gained significant attention, with multiple studies evaluating their effectiveness and associated complications (Al-Tarawneh et al., 2024; Minniti et al., 2024). This systematic review synthesizes evidence from randomized controlled trials (RCTs), highlighting clinical outcomes, limitations, and their potential as alternatives to conventional grafting techniques.

The combination of soft tissue expanders with guided bone regeneration (GBR) has demonstrated promising results in alveolar ridge augmentation (Passarelli et al., 2024; Seo et al., 2023; Slavin et al., 2024), showing improved soft tissue volume and favorable bone regeneration.

Byun et al. (2020) reported significantly greater vertical bone gain in expander-treated patients compared to controls (5.12 ± 1.25 mm vs. 4.22 ± 1.15 mm; $p < 0.05$), despite minor complications such as

over-expansion and mucosal perforation (Byun, Kim, Lee, et al., 2020). Similarly, Ali et al. (2023) found comparable bone width between groups but superior bone quality, vascularization, and collagen maturation in the expander group, indicating improved graft integration (Ali et al., 2023).

Tawfik et al. (2023) observed greater bone volume gain (1.95 cm^3, $p = 0.05$) and improved soft tissue stability, while another study by Byun et al. (2020) reported higher vertical bone gain and reduced early bone resorption (Byun, Kim, Cho, et al., 2020). Abrahamsson et al. (2012) and Shomurodov et al. (2023) further supported these findings, though soft tissue perforations and infections were occasionally reported. Overall, these complications were infrequent and manageable, suggesting that the benefits of expanders outweigh the risks when appropriately applied.

LIMITATION:

While the reviewed studies provide encouraging evidence regarding the use of soft tissue expanders in guided bone regeneration (GBR), several limitations must be acknowledged.

Small Sample Sizes: Many studies, including those by Ali et al. (2023) and Abrahamsson et al. (2012), involved limited patient numbers, restricting generalizability and reducing statistical power.

Short Follow-Up Periods: Most studies reported outcomes within 6 months to 1 year. Although Byun et al. (2020) and Tawfik et al. (2023) demonstrated promising short-term results, longer follow-up is needed to assess long-term bone stability and implant success, particularly in high-resorption regions such as the posterior mandible.

Complications and Risk Factors: Complications such as soft tissue perforation, infection, and over-expansion were reported, though infrequently. Abrahamsson et al. (2012) noted higher bone resorption in smokers, emphasizing the influence of patient-related factors. Further evaluation of systemic and behavioral risks is required.

Lack of Consistency in Methods: Variations in expander designs, grafting materials, and surgical techniques complicate direct comparison of outcomes. The use of different graft types in studies such as Shomurodov et al. (2023) and Byun et al. (2020) highlights the need for standardized protocols.

Limited Focus on Functional Outcomes: Most studies emphasized radiographic bone gain rather than long-term functional or patient-reported outcomes. Although some, such as Shomurodov et al. (2023), evaluated implant stability, broader assessments remain limited.

Future Directions: Future research should prioritize larger, multicenter trials with extended follow-up periods of 3–5 years to assess bone stability, peri-implant tissue health, and implant survival. Comparative studies on grafting materials used with expanders are needed to identify optimal regenerative combinations. Technological advancements may help reduce complications and improve predictability. Importantly, incorporating patient-reported outcomes such as esthetic satisfaction, comfort, and functional performance will provide a more comprehensive evaluation of clinical success.

Conclusion:

This systematic review concludes that the use of soft tissue expanders, particularly self-inflating hydrogel models, significantly enhances both vertical and horizontal bone augmentation. The expanders provide not only hard tissue benefits but also contribute to improved soft tissue outcomes, such as soft tissue thickness and stability, which are crucial for long-term implant success. Despite the occasional complications related to over-expansion or tissue perforation, the overall outcomes appear favorable, with expanders showing reduced bone resorption and improved bone quality. Further refinement of the technique, especially in high-risk groups such as smokers, could further optimize the predictability and success of these procedures.

Acknowledgements

The authors acknowledge financial support from the Department of Science and Technology (DST), Government of India, under Technology Development Programme (Grant No. DS/TDT/TDP-63/2022

References:

1)Abrahamsson, P., Wälivaara, D.-Å., Isaksson, S., & Andersson, G. (2012). Periosteal expansion before local bone reconstruction using a new technique for measuring soft tissue profile stability: a clinical study. *Journal of Oral and Maxillofacial Surgery: Official Journal of the American Association of Oral and Maxillofacial Surgeons*, *70*(10), e521–e530.

2)Ali, A. T., Kheir El-Din, N. H., Ali, M., Abdelhamid, E. S., & Amr, A. E. (2023). The influence of self-inflating soft tissue expander on the outcomes of horizontal alveolar ridge augmentation: A randomized controlled clinical and histological study. *Clinical Oral Implants Research*, *34*(5), 426–437.

3)Al-Tarawneh, S. K., Thalji, G., Fernandez Lozada, M., Waia, D., & Cooper, L. F. (2024). Comparing single-tooth implant placement with and without allogeneic soft tissue augmentation: A randomized clinical trial. *The International Journal of Oral & Maxillofacial Implants*, *39*(5), 684–698.

4)Byun, S.-H., Kim, S.-H., Cho, S., Lee, H., Lim, H.-K., Kim, J.-W., Lee, U.-L., Song, W., Kim, S.-J., Kim, M.-K., & Kim, J.-W. (2020). Tissue expansion improves the outcome and predictability for alveolar bone augmentation: Prospective, multicenter, randomized controlled trial. *Journal of Clinical Medicine Research*, *9*(4), 1143.

5)Byun, S.-H., Kim, S.-Y., Lee, H., Lim, H.-K., Kim, J.-W., Lee, U.-L., Lee, J.-B., Park, S.-H., Kim, S.-J., Song, J.-D., Jang, I.-S., Kim, M.-K., & Kim, J.-W. (2020). Soft tissue expander for vertically atrophied alveolar ridges: Prospective, multicenter, randomized controlled trial. *Clinical Oral Implants Research*, *31*(7), 585–594.

6)Garner, J., Davidson, D. D., Barwinska, D., Eckert, G. J., Tholpady, S. S., Park, K., & Barco, C. T. (2019). Reshapable hydrogel tissue expander for ridge augmentation: Results of a series of successive insertions at the same intraoral site. *Journal of Periodontology*, *90*(7), 718–727.

7)Herford, A. S., Nguyen, K., Miller, M., Tandon, R., & Signorino, F. (2019). Evaluation of the safety and efficacy of soft tissue augmentation with a compressive-resistant collagen matrix in a nonhuman primate model. *Journal of Oral and Maxillofacial Surgery: Official Journal of the American Association of Oral and Maxillofacial Surgeons*, *77*(3), 615–628.

8)Mertens, C., Thiele, O., Engel, M., Seeberger, R., Hoffmann, J., & Freier, K. (2015). The use of self-inflating soft tissue expanders prior to bone augmentation of atrophied alveolar ridges: Soft tissue expanders prior to bone augmentation. *Clinical Implant Dentistry and Related Research*, *17*(1), 44–51.

9)Minniti, A., Caroprese, M., Zarantonello, M., De Santis, D., Caliendo, G., & Gelpi, F. (2024). High-density dermal matrix for soft tissue augmentation using a matrix tissue graft technique-A comprehensive multicenter analysis of 20 implants: A 1-year follow-up retrospective study. *Journal of Clinical Medicine*, *13*(10), 2954.

10)Passarelli, P. C., Lopez, M. A., Netti, A., Felicetti, A., Wychowański, P., Garcia-Godoy, F., Chiapasco, M., & D'Addona, A. (2024). Alveolar regeneration of the post-extraction site with cortical deficiency using the Lamina Socket Sealing technique: Retrospective study with histomorphometric analysis of regenerated bone and evaluation of soft tissue changes. Part 2/2. *American Journal of Dentistry*, *37*(SIA), 9A – 12A.

11)Rojo, E., Stroppa, G., Sanz-Martin, I., Gonzalez-Martín, O., Alemany, A. S., & Nart, J. (2018). Soft tissue volume gain around dental implants using autogenous subepithelial connective tissue grafts harvested from the lateral palate or tuberosity area. A randomized controlled clinical study. *Journal of Clinical Periodontology*, *45*(4), 495–503.

12)Selvaprithiviraj, V., Vaquette, C., & Ivanovski, S. (2023). Hydrogel based soft tissue expanders for orodental reconstruction. *Acta Biomaterialia*, *172*, 53–66.

13)Seo, G.-J., Lim, H.-C., Chung, J.-H., Kim, G., Shin, S.-I., Chang, D.-W., & Shin, S.-Y. (2023). Soft tissue outcomes following alveolar ridge preservation with/without primary flap closure for periodontally damaged extraction socket: A randomized clinical trial. *Clinical Implant Dentistry and Related Research*, *25*(5), 929–937.

14)Shomurodov, K., Mirkhusanova, R., & Bone Regeneration Of, A. N. (2023). Received 2022-12-25; Accepted 2023-02-18; Published 2023-05-10. *Journal of Health and Translational Medicine*, *26*(1), 170–178.

15)Slavin, B. V., Stauber, Z. M., Ehlen, Q. T., Costello, J. P., 2nd, Tabibi, O., Herbert, J. E., Mirsky, N. A., Nayak, V. V., Daunert, S., Witek, L., & Coelho, P. G. (2024). Evaluation of porcine-derived collagen membranes for soft tissue augmentation in the oral cavity: An in vivo study. *The Journal of Craniofacial Surgery*.
https://doi.org/10.1097/SCS.0000000000010482

16)Somodi, K., Dobos, A., Bartha, F., Solyom, E., Windisch, P., Palkovics, D., & Molnar, B. (2024). Changes in soft tissue dimensions following horizontal guided bone regeneration with a split-thickness flap design - evaluation of 8 cases with a digital method. *Head & Face Medicine*, *20*(1), 53.

17)Strauss, F. J., Gil, A., Smirani, R., Rodriguez, A., Jung, R., & Thoma, D. (2024). The use of digital technologies in peri-implant soft tissue augmentation - A narrative review on planning, measurements, monitoring and aesthetics. *Clinical Oral Implants Research*, *35*(8), 922–938.

18)Tavelli, L., Barootchi, S., Rodriguez, M. V., Meneghetti, P. C., Mendonça, G., & Wang, H.-L. (2023). Volumetric outcomes of Peri-implant soft tissue augmentation with a xenogeneic cross-linked collagen scaffold: A comparative clinical study. *The*

International Journal of Periodontics & Restorative Dentistry, *43*(4), 415–422.

19)Tawfik, B. E. A., El-Sayed, A. K., Mohamed, R. E., Elsayed, S. A., & Hosny, M. M. (2023). Tissue expander followed by autogenous bone graft versus autogenous bone graft alone for mandibular reconstruction: Quantitative assessment. *The Journal of Craniofacial Surgery*, *34*(1), e52–e57.

20)Zhang, H., Xu, T., Wei, Y., Wei, N., Han, Z., & Hu, W. (2024). Assessment of soft and hard tissue changes following micro crestal flap-Alveolar ridge preservation and augmentation at molar extraction sites in patients with stage III/IV periodontitis: A randomized controlled trial. *Journal of Clinical Periodontology*, *51*(10), 1311–1322.