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ORIGINAL ARTICLE

Meta-Analysis Study between Minimal Access Cranial Suspension (MACS) Lift and Superficial Musculo-Aponeurotic System (SMAS) Plication Techniques in Face Lift

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Abstract:

Background: Patients seeking plastic surgery frequently want to hide the signs of aging, and every year there is a growing need for a facial rejuvenation technique that is more efficient, quicker, and more durable. The purpose of this meta-analysis was to assess the patient satisfaction and complication rate of the MACS-lift and SMAS plication techniques for face lifting.

Methods: Four reviewers independently carried out data extraction with regard to review a facelift technique and report surgical outcomes including complications and/or adverse effects and reported outcomes with a follow-up period of at least six months to ensure sufficient postoperative data. The Oxford Center for Evidence-Based Medicine Criteria were used to evaluate the listed studies' quality.

Results: A total of 617 studies, eight distinct were selected for inclusion in the meta-analysis, found That SMAS plication technique duration is longer than MACS Lift intervention with MDs and 95% CI;56.8[91.1,22.45] (P-value=0.001). That concurrent non-facial procedures had more prevalent significance in MACS Lift group than SMAS group with RR and 95% CI;0.04 [0.001,0.6], P-value=0.02. P-value Is significant favoring MACS Lift. no significant difference between SMAS plication technique and MACS Lift intervention regarding follow up time in days with MD and 95% CI;18.8 [147.38,109.78], P-value=0.77. P-value is not significant**.** **Conclusion:** MACS technique demonstrated a statistically significant reduction in procedural length when compared to SMAS plication technique. In contrast, the MACS-lift approach significantly reduced the average follow-up time in days and statistically significantly increased the number of concurrent non-facial treatments as compared to the SMAS plication technique.

Keywords: MACS-lift; SMAS plication; meta-analysis study of face lifting techniques.

INTRODUCTION

A surgical treatment called "face lifting" is done to enhance the appearance of an aging face. One of the oldest and most important procedures in plastic surgery is the facelift. Other less invasive methods, like thread lifting and radiofrequency treatments, have been attempted by cosmetic surgeons to rejuvenate the face, but they have not proved as successful as typical surgical face-lift methods[1,2].

Therefore, for plastic surgeons who focus on rejuvenation, it is crucial to completely comprehend the evolution of the rhytidectomy technique. Miller [3] and Passot [4] defined the earliest rhytidectomy procedures includes subcutaneous sectioning of the face muscles and irregular ellipsoidal skin excisions to remove the buccolabial sulcus and cheek wrinkles in the early 1900s.

In the late 1990s, SMAS manipulation techniques flourished, with SMAS plication, SMASectomy Baker [5], S-lift Saylan [6], and MACS lift Tonnard et al. [7] presented by Baker, Saylan, Tonnard, and Robbins [8], in that order. These methods have maintained consistent and dependable cosmetic outcomes while reducing the rate of complications, scar visibility, and healing time. Surgeons focused on developing customized surgical procedures and algorithms in the 2000s to address patients' diverse facial problems [9,10].

The method created by Tonnard and Vaerpele is currently among the most popular short-scar rhytidectomy techniques. The technique, which uses purse-string sutures and minimal skin undermining, has been thoroughly described in order to accomplish a clear vertical repositioning (which leads to genuine lifting with a strict vertical vector) as opposed to a lateral draw leaving a sling. The superficial musculo-aponeurotic system (SMAS) is tightened to achieve this which causes the skin to reposition more cranially without being pulled (figure 1) [11,12].

Since the initial description of the minimal access cranial suspension (MACS) lift in the literature in 2002, facial plastic surgeons have widely adopted and utilized the procedure worldwide. Eighteen years after its debut, a comprehensive analysis of the MACS lift's outcomes and side effects is provided to determine its current standing in facial rejuvenation[13].

Real worth of the short-scar facelifting or, for that matter, the MACS lift. As originally recommended by Tonnard and Verpaele, it also demonstrates that the surgery, which is frequently combined with other procedures, produces noticeable patient satisfaction with a comparatively low complication rate. However, other trials indicated insufficient skin laxity and neck contouring, and further procedures, such as tuck procedures, were often required to achieve a desirable outcome. Consequently, it can be presumed that the MACS lift has no widespread impact on the neck region. Even with more extensive facelift procedures, recurrence of neck laxity and platysma bands is problematic, as explained in the award-winning study by Pelle-Ceravolo, Angelini, and Silvi, unless further specialized neck procedures are carried out [14]. One of the most popular short-scar rhytidectomy techniques now in use is the Tonnard and Vaer-Pele-developed minimal access cranial suspension (MACS) lift. To achieve a distinct vertical tissue repositioning, the method combines purse-string sutures with minimal skin undermining.

Aim of the work

In terms of patient satisfaction and complication rate, this meta-analysis compares the Lift from the Superficial Musculo-Aponeurotic System vs Minimal Access Cranial Suspension (SMAS) plication approach in face lifting.

METHODS

We conducted this meta-analysis and systematic review in the faculty of medicine, plastic and reconstructive surgery, Zagazig University, between 2005 and 2023. according to the guidelines outlined in the Meta-analyses of Observational Studies in Epidemiology (MOOSE) and Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statements. The literature on face lifting treatments (MeSH) terminology related to face lifting techniques was retrieved from reliable web-based sources, specifically PubMed and Google Scholar, using pertinent keywords and Medical Subject Headings. We used search terms such as SMAS plication, MACS-lift, meta-analysis study on face lifting methods, etc. Ethical permission was granted by the Institutional Review Board of Zagazig, Egypt. Every technique was revealed in accordance with Zagazig's ethical guidelines (IRBZU-IRB#117). The work was conducted in compliance with the World Medical Association's Code of Ethics (Declaration of Helsinki, 1964) and its subsequent unifications for human subjects research.

Peer-reviewed English-language studies that mentioned the technique and its modifications, that described or reviewed a facelift procedure and documented surgical results, such as side effects and/or problems, that were published between 2005 and 2023 to ensure that the surgical techniques and outcomes were up to date, that included a minimum sample size of 10 patients, and that had a follow-up period of at least six months to ensure adequate postoperative data were all included in the pre-defined inclusion criteria. Articles that describe or review non-cosmetic procedures, articles about isolated neck lifts, isolated subperiosteal midface lifts, brow lifts, forehead lifts, or isolated thread lifting, articles written in languages other than English, editorials, case reports, review articles, experimental studies, case reports with fewer than ten patients, studies that only reported successful cases, and articles written in languages other than English were all excluded.

Four reviewers independently collected data from a Microsoft Excel spreadsheet use a defined form for data extraction. Skin necrosis, major/minor hematoma, seroma, infection, facial nerve damage, long-term results, patient satisfaction, comorbidities, facelift type, author, country, study methodology, sample size, mean patient age, sex, body mass index, and comorbidities were all taken out of each of the chosen studies. Any disagreements regarding the data extraction were settled through dialogue or by speaking with a fifth author.

Quality assessment and level of evidence

The quality of the selected studies was assessed using the Methodological Index for Non-Randomized Studies (MINORS). The MINORS is a validated tool for assessing the quality of non-randomized research designs, including comparative observational studies, cohort studies, and case-control studies. It has eight items for comparative studies and twelve for non-comparative studies, with a maximum score of 24 for comparative studies and 16 for non-comparative studies. Every item has a score between 0 and 2. After two authors independently assessed the research using the MINORS tool, disagreements were resolved by discussion or by speaking with a third author.

If a study received a score higher than or lower than the median for its type, it was deemed to be of excellent quality. Additionally, we used the American Society of Plastic Surgeons' (ASPS) levels of evidence and recommendation grading to assess the quality of evidence for each study included in the evaluation. Level V is the least amount of evidence, and Level I is the most, the ASPS level of evidence classifies research according to their design and quality of evidence. Based on the amount of evidence, the grading system gives each study a recommendation strength, with Grade A denoting the strongest recommendation and Grade C the weakest. Each study's evidence levels and recommendation grades were evaluated independently by two authors. Any disagreements were settled through dialogue or by speaking with a third author.

Outcomes

The patient's and/or surgeon's assessment of the long-term effects, satisfaction, and complications of the MACS lifting and smas plication procedures were the main outcomes of interest.

Statistical analysis

The IBM computer used SPSS (statistical application for social science, version 23) to analyze the data in the following ways: Mean, SD, median, and IQR are examples of quantitative variables. The data distribution is examined using the Shapiro test of normalcy. Numbers and percentages are used to describe qualitative characteristics. Using the chi-square test, qualitative characteristics were compared between groups. When one or more predicted cells are less than five, the Fisher exact test is utilized. Two groups were compared quantitatively using the independent T test. For non-parametric data (SD > 30% mean), the Mann Whitney test was employed rather than the unpaired t-test. To identify factors that predict hospital stays, several linear regression models were used. Quality of life predictors were found using multiple binary logistic regressions. $P < 0.05$ indicates significance, $P > 0.05$ indicates insignificance.

RESULTS

After searching several databases, we discovered 617 included studies. Eight different publications satisfied our eligibility requirements and were included in our study after 312 duplicates were eliminated, 305 studies were assessed for title and abstract, and 36 studies were checked for full text eligibility.

Figure 2: represents PRISMA flow chart for study selection process.

Baseline characteristics of included studies: All eight of the included studies had a retrospective cohort design, a variable geographic distribution, and a total sample size of 1379 people. To learn more about the baseline features of the studies we included, check Table 1.

Using the NIH methodology, we evaluated the risk of bias and the quality of our included cohort. All of our studies had fair quality, with the exception of Mast 2014 and Yu 2020, which had good quality. Table 2 represent Risk of bias summary of our included studies. Also see Supplementary Table 1for more details.

Outcomes:

One trial comprising 46 patients was included in our meta-analysis. It revealed that the SAMS method took less time than the traditional intervention with MDs, with a 95% confidence interval of 0.09[0.3, 0.48] and a significant (P-value=0.001) preference for the SAMS approach. Figure 3 represent the forest plots for procedure duration.

Regarding concurrent face operations, our meta-analysis of this outcome, which comprised one research with 46 patients, revealed no significant difference between the SAMS technique and the traditional intervention (RR and 95% CI: 1.09[0.71, 1.67], P-value=0.71). The P-value is not noteworthy. Figure 4 represent the forest plots for concurrent facial procedures.

Regarding concurrent non-facial treatments, our meta-analysis of this outcome, which comprised one research with 46 patients, revealed no significant difference between the SAMS technique and the traditional intervention with RR and 95% CI; 8.23[0.5,135.4], P-value=0.14. The P-value is not noteworthy. Figure 5 represent the forest plots for concurrent Non facial procedures.

There was no significant difference between the SAMS technique and the traditional intervention in terms of follow-up time in days with MD, according to our meta-analysis of one trial that included 46 patients; the 95% CI was 18.8[147.38, 109.78], with a P-value of 0.77. The P-value is not noteworthy. Figure S1 represent the forest plots for average follow up time in days.

Table (1): Summary for Baseline characteristics of included studies

Study NO.	Study ID	Country	Study design	Sample size	Age	Gender (Female)	BMI	Intervention
1	Buchanan 2018	Florida	Retrospective, non-randomized, non-blinded, controlled, cohort study	16	64.8	15	24.2	Traditional
				30	60.2	28	23.5	MACS Lift
2	Mohammadi 2015	Iran	Retrospective comparative cohort study	9	53 ± 6.7	2	25	SAMS lift
				9				MACS lift
3	Prado 2005	Chile	Retrospective, non-randomized, blinded, controlled study	41	47	80	NA	Lateral SMASectomy
				41				MACS lift

Study NO.	Study ID	Country	Study design	Sample size	Age	Gender (Female)	BMI	Intervention
4	Tonnard 2005	Belgium	Retrospective, non-randomized, non-blinded, non-controlled study	450	57	415	NA	Traditional MACS lift
5	Verpaele 2006	British	Retrospective cohort study	557	55	NA	NA	MACS lift
6	Willemsen 2011	Netherlands	Retrospective, non-randomized, single-blinded, controlled study	42	50.8	NA	NA	MACS lift with adjuvant lipofillin
				50				MACS lift
7	Yu 020	China	Retrospective, non-randomized, non-blinded, non-controlled study	46	50.7 ± 6.4	46	NA	Elastic thread MACS lift
8	Mast 2014	North Carolina	Retrospective, non-randomized, non-blinded, controlled.	8	59	85	NA	Traditional facelift
				80				MACS lift

NA: Not Assessed

Table (2): Risk of bias summary of our included studies

Study ID	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
Prado 2005	Yes	Yes	Yes	Yes	NR	Yes	Yes	NR	Yes	NR	NR	NR	Yes	Yes
Tonnard 2005	Yes	Yes	Yes	NR	NR	Yes	Yes	NR	Yes	NR	NR	NR	Yes	Yes
Mohammadi 2015	Yes	Yes	Yes	NR	NR	Yes	Yes	NR	Yes	NR	NR	NR	Yes	Yes
Buchanan 2018	Yes	Yes	Yes	Yes	NO	Yes	Yes	NR	Yes	NR	NR	NR	Yes	Yes
Verpaele 2006	Yes	Yes	Yes	Yes	NR	Yes	Yes	NR	Yes	NR	Yes	NR	Yes	Yes
Willemsen 2011	Yes	Yes	Yes	Yes	NR	Yes	Yes	NR	Yes	NR	Yes	NR	Yes	Yes
Yu 2020	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NR	Yes	NR	Yes	NR	Yes	Yes
Mast 2014	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NR	Yes	NR	Yes	NR	Yes	Yes

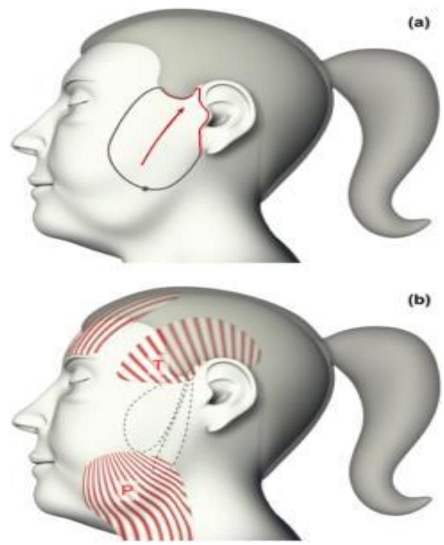

Figure (1): Minimal Access Cranial Suspension (MACS) lift. (a) The incision (red) and skin undermining (black) in the MACS lift. The vector of correction is almost vertical (red arrow). (b) Projection of the two purse-string sutures (dashed lines) and their relationship to the temporalis (T) and platysma (P) muscles [12].

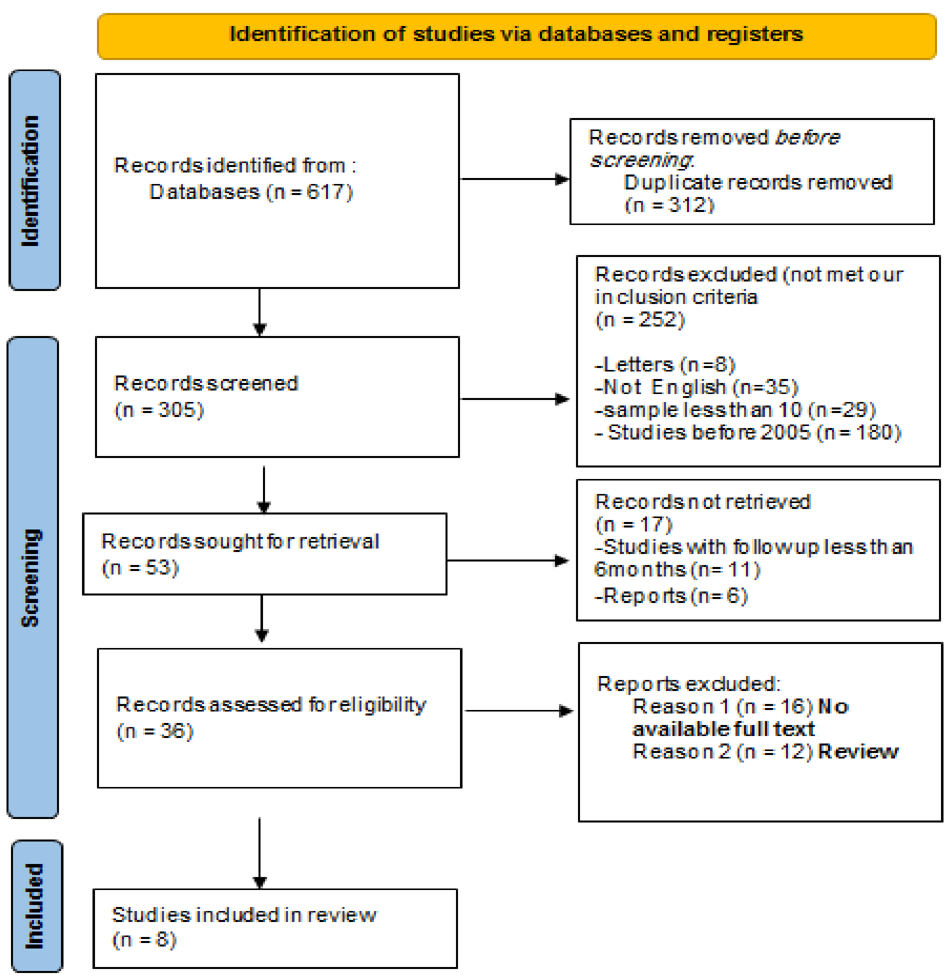

Figure (2): PRISMA flow chart for study selection process.

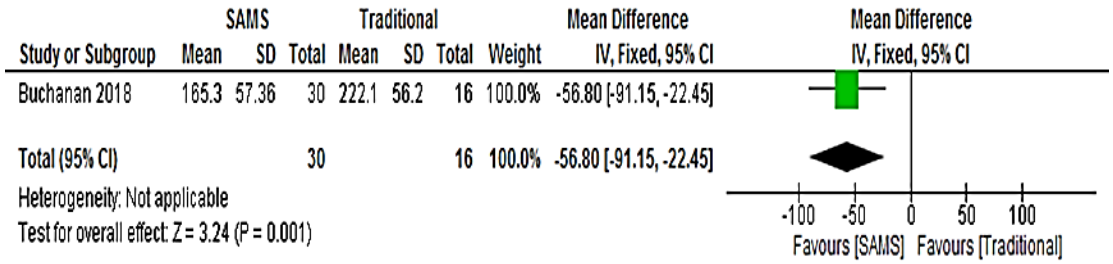

Figure (3): Forest plot for procedure duration.

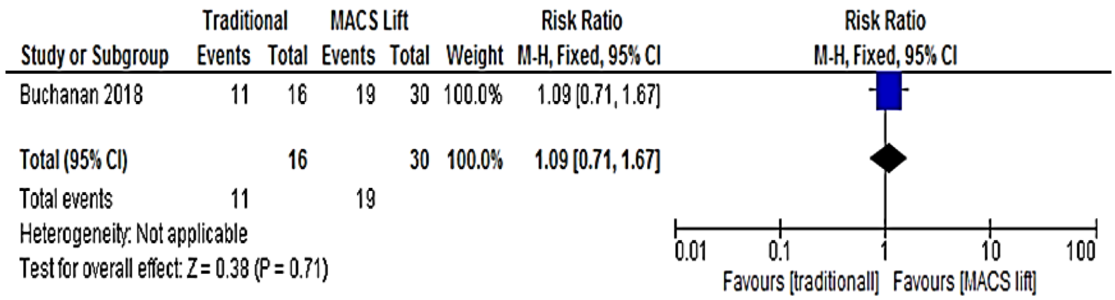

Figure (4): Forest plot for Concurrent facial procedures.

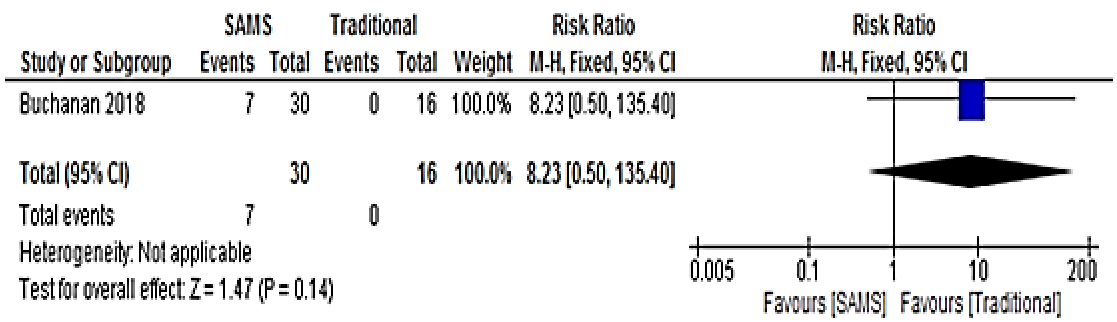

Figure (5): Forest plot for concurrent non facial procedures.

DISCUSSION

After searching several databases, we discovered 617 included studies. After removing 312 duplicates, 305 studies were assessed for title and abstract, 36 articles were checked for full text eligibility, and eight research were ultimately included [7, 15-20]. All of our investigations had a retrospective cohort design, a variable geographic distribution, and a total sample size of 1379 people.

Using the NIH methodology, we evaluated the risk of bias and the quality of our included cohort. All of our studies had fair quality, with the exception of Yu [20], which had good quality.

One study with 46 patients was included in our meta-analysis, which revealed that the MACS-lift approach is preferred because it takes less time than the SMAS plication technique [165.3 (96–255) vs. 222.1 (151–308) min; P-value=0.000].

Buchanan et al., a study with 46 patients, found no significant difference between the MACS-lift and SMAS plication technique with regard to concurrent facial procedures [19 (63.3%) vs. 11 (68.75%); P-value=0.713]. This was one of the studies included in our meta-analysis for this outcome [19].

Our meta-analysis of this outcome, which included one study with 46 patients, revealed that the MACS-lift technique significantly increased the number of concurrent non-facial procedures when compared to the SMAS plication technique [7 (23.3%) vs. 0 (0%); (P = 0.035)].

Our meta-analysis for this outcome included one study with 46 patients, and it revealed that the MACS-lift technique significantly reduced the average follow-up time in days when compared to the SMAS plication technique [152.8 (22–773) vs. 171.6 (50–528); P-value=0.034].

33 patients out of 557 who were enrolled in the Verpaele et al. [16] study (MACS lift) experienced minor problems, while 2 patients out of 41 who were enrolled in the Prado et al. [15] study (Lateral SMAS ectomy) experienced hematomas and retro-auricular lobule. The current thesis can be discussed as following:

The mainstay of facial rejuvenation is a facelift, often known as a rhytidectomy. From restricted lift with SMAS manipulation to subcutaneous lift, subcutaneous musculoaponeurotic system (SMAS) lift, composite lift, separate skin, and SMAS flap lift, face lifting has undergone continuous evolution since Miller first described it in the early 1900s as irregular ellipsoidal skin excisions in wrinkles that occur naturally. To meet the distinct volumetric needs, vectors, and facial forms of each patient, plastic surgeons have recently concentrated on creating customized treatment programs [21].

A minimally invasive technique for face rejuvenation is thread lift. It is a good substitute for more invasive procedures since it provides patients with short operating times, little scarring, quick recovery, and few problems [22].

However, not all patients can benefit from thread lifting, particularly those who require excision of excess skin. Consequently, the modified minimum access cranial suspension (MACS) lift is used to treat patients who have significant skin sagging [32]. In similar previous meta-analysis Jacono et al. [33] observed that any blood collection requiring surgical intervention was considered a major hematoma. Any blood collection that was conservatively handled by either aspirating the needle or placing a drain was referred to as a minor hematoma. Furthermore, information about which specific nerve branches (facial, zygomatic, buccal, marginal mandibular, and cervical) were classified, documented, and included for analysis was provided when there was either temporary or permanent nerve damage. The frequency (percent) and count (n) of each complication served as the outcome measures. High lateral SMAS (0.62%, n = 1122), deep plane (1.22%, n = 287), composite (0.32%, n = 312), SMAS plication (0.73%, n=5719), SMASectomy/ imbrication (1.92%, n = 2081), and SMAS flap (0.85%, n = 8468) all had major hematomas. The odds ratio of major hematoma for SMASectomy/imbrication against SMAS plication technique (OR = 2.64, 95% CI = 1.71 to 4.10, $P < 0.01$) and deep plane versus SAMS plication technique (OR = 1.68, 95% CI = 1.04 to 2.71, $P < 0.05$) increased statistically significantly. The odds ratio of minor hematoma was statistically significantly lower for SMAS flap vs. SMAS plication technique (OR = 0.46, 95% CI = 0.34 to 0.62, $P < 0.01$) and high lateral SMAS vs. SMAS plication technique (OR = 0.07, 95% CI = 0.02 to 0.3, $P < 0.01$). The odds ratio of minor hematoma using SMASectomy/imbrication was statistically significantly higher than that of SMAS plication approach (OR = 1.76, 95% CI = 1.7 to 2.45, $P < 0.01$).

Yu et al. [20] stated that, with reference to the technique's safety and complications, they had slight swelling, seromas, and some postoperative pain, the most of which are self-limiting and can be resolved with the right care. After a brief convalescence, every patient recovered nicely. There were no serious side effects found, including nerve damage, infection, hematoma, skin necrosis, or hair loss.

Prado et al. [15] observed that the complications included two cases of retro auricular-lobule dog ears (both requiring minimal access cranial suspension lift) that required surgical revision, one case of hypertrophic preauricular scars (minimum access cranial suspension lift), and two hematomas, one for each technique, which were treated right away after the procedure was completed. There was no visible damage to the facial nerves. The minimal access cranial suspension lift (median, 165 minutes) took less time to do than the SMA Sectomy (median, 190 minutes) ($p = 0.0011$, Wilcoxon). There was a statistical difference ($p < 0.0001$, Wilcoxon) between the postoperative pain scores for SMA Sectomy and minimal access cranial suspension lift cases, which were 6 (4to 3) and 4 (3to 4), respectively.

Eremia and Willoughby [34] revealed that by six months, the correction had begun to wane, and by twelve months, 80–100% of the correction seemed to have disappeared.

Garvey et al. [35] discovered that there was a significant frequency of revision procedures after a Contour Thread lift, and that the time to revision was brief.

Jacono et al. [33] compared all methods using logistic modeling and failed to identify a statistically significant difference in the probability of permanent harm. Because of the extensive redundancy in these motor divisions, which makes persistent deficiency improbable, it is noteworthy that no permanent damage to the buccal or zygomatic branches were observed. The zygomatic branches are innervated by the orbicularis muscle, which it dissects beneath, the greater danger to this division in the composite facelift has an anatomic counterpart. The zygomatic branches are once more at risk during SMASectomy, which involves removing a strip of SMAS along a line from the mandibular angle to the lateral canthus covering the orbicularis.

Coleman et al. [36] observed that repositioning the ptotic soft tissues and, if necessary, correcting volume deficiencies are essential for the best rejuvenation of the aging face. made popular by Coleman.

Conclusion

In terms of concurrent face operations, we find no significant difference between the MACS-lift and SMAS plication techniques, however A statistically significant decrease in procedural length was demonstrated by the MACS approach. when compared to the latter. In contrast, the MACS-lift approach significantly reduced the average follow-up time in days and statistically significantly increased the number of concurrent non-facial treatments as compared to the SMAS plication technique. However, a larger, more powerful study with a larger sample size is needed to corroborate these findings.

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Conflict of interest:

The authors declare that they have no conflicts of interest with respect to authorship or publication ofthis article .

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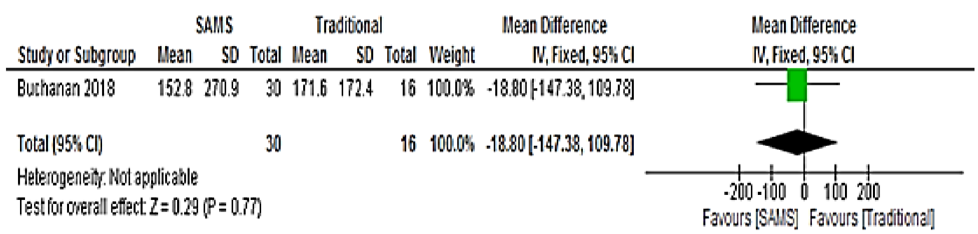

Figure S1: Forest plots for average follow up time in days.

Citation

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