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POSTOPERATIVE SEROMA AFTER ABDOMINOPLASTY RISK FACTORS AND PREVENTION STRATEGIES: A STRUCTURED NARRATIVE REVIEW

SEROMA PÓS-OPERATÓRIO APÓS ABDOMINOPLASTIA: FATORES DE RISCO E ESTRATÉGIAS DE PREVENÇÃO – UMA REVISÃO NARRATIVA ESTRUTURADA

SEROMA POSOPERATORIO TRAS ABDOMINOPLASTIA: FACTORES DE RIESGO Y ESTRATEGIAS DE PREVENCIÓN; UNA REVISIÓN NARRATIVA ESTRUCTURADA

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ABSTRACT

Background: Seroma is a common local complication after abdominoplasty, but reported frequencies vary with operative technique, patient selection, and whether diagnosis is clinical or ultrasound-based. Drain output and seroma requiring treatment are related but distinct outcomes. Objective: To critically evaluate patient and operative risk factors and the evidence supporting seroma prevention after abdominoplasty. Methods: A targeted PubMed-based narrative review examined randomized trials, prospective studies, comparative cohorts, and systematic reviews available through October 24, 2026. Evidence was interpreted with attention to outcome definitions, cointerventions, and the distinction between seroma-specific and overall complication risk. Results: Higher body mass index and greater operative tissue disruption are associated with seroma in several cohorts, while the contribution of liposuction varies according to dissection and dead-space management. Progressive tension or quilting sutures and preservation of Scarpa fascia have the most consistent supportive evidence, although effect sizes are influenced by study design and technique. A comparative meta-analysis reported a seroma risk ratio of 0.34 for progressive tension suturing versus conventional drains; a 2026 Scarpa-preservation synthesis reported a similar pooled association, driven predominantly by observational evidence. More drains have not consistently improved outcomes. A small randomized trial found no additional seroma-prevention benefit from abdominal binders after quilting-suture abdominoplasty. Adhesives, energy devices, tranexamic acid, and negative-pressure dressings require outcome-specific interpretation. Conclusions: Prevention should address dead space, shear, tissue injury, and patient risk. A reproducible operative and follow-up protocol is more defensible than assuming that any single adjunct universally prevents seroma.

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Keywords: Abdominoplasty. Seroma. Progressive Tension Sutures. Quilting Sutures. Scarpa Fascia. Postoperative Complications.

RESUMO
Contexto: O seroma é uma complicação local comum após a abdominoplastia; contudo, as frequências relatadas variam de acordo com a técnica cirúrgica, a seleção dos pacientes e se o diagnóstico é estabelecido por meio de avaliação clínica ou ultrassonografia. O volume de drenagem e a ocorrência de seroma que exige tratamento são desfechos relacionados, porém distintos. Objetivo: Avaliar criticamente os fatores de risco — tanto relacionados ao paciente quanto ao procedimento cirúrgico — e as evidências que sustentam as estratégias de prevenção de seroma após a abdominoplastia. Métodos: Foi realizada uma revisão narrativa baseada no PubMed, abrangendo ensaios clínicos randomizados, estudos prospectivos, coortes comparativas e revisões sistemáticas disponíveis até 24 de outubro de 2026. As evidências foram interpretadas considerando as definições dos desfechos, as intervenções associadas e a distinção entre o risco de seroma especificamente e o risco de complicações em geral. Resultados: Um índice de massa corporal (IMC) mais elevado e uma maior dissecção tecidual durante a cirurgia estão associados ao surgimento de seroma em diversos estudos de coorte. A contribuição da lipoaspiração, por sua vez, varia conforme a extensão da dissecção e o manejo do espaço morto. As suturas de tensão progressiva (ou suturas de fixação/capitonagem) e a preservação da fáscia de Scarpa apresentam as evidências mais consistentes, embora a magnitude do efeito varie de acordo com o desenho do estudo e a técnica empregada. Uma metanálise comparativa indicou uma razão de risco (risco relativo) de 0,34 para o uso de suturas de tensão progressiva em comparação com o uso de drenos convencionais; uma síntese de 2026 sobre a preservação da fáscia de Scarpa apontou uma associação combinada semelhante, fundamentada predominantemente em evidências observacionais. O aumento do número de drenos não demonstrou melhoria consistente nos resultados. Um pequeno ensaio clínico randomizado não encontrou benefício adicional na prevenção de seroma com o uso de cintas abdominais após abdominoplastia com suturas de fixação. O uso de adesivos, dispositivos de energia, ácido tranexâmico e curativos de pressão negativa requer uma interpretação específica para cada desfecho analisado. Conclusões: A prevenção deve abordar o espaço morto, as forças de cisalhamento, a lesão tecidual e os fatores de risco do paciente. É mais fundamentado adotar um protocolo cirúrgico e de acompanhamento reprodutível do que pressupor que um único recurso adjuvante seja capaz de prevenir o seroma em todos os casos.

Palavras-chave: Abdominoplastia. Seroma. Suturas de Tensão Progressiva. Suturas de Fixação (Capitonagem). Fáscia de Scarpa. Complicações Pós-operatórias.

RESUMEN
Antecedentes: El seroma es una complicación local frecuente tras una abdominoplastia; sin embargo, las frecuencias notificadas varían según la técnica quirúrgica, la selección de los pacientes y si el diagnóstico se establece de forma clínica o mediante ecografía. El volumen de drenaje y la aparición de un seroma que requiere tratamiento son resultados relacionados, pero distintos. Objetivo: Evaluar de manera crítica los factores de riesgo —tanto del paciente como quirúrgicos— y la evidencia que respalda las estrategias para prevenir el seroma tras una abdominoplastia. Métodos: Se realizó una revisión narrativa basada en PubMed que examinó ensayos aleatorizados, estudios prospectivos, cohortes comparativas y revisiones sistemáticas disponibles hasta el 24 de octubre de 2026. La evidencia se analizó prestando atención a las definiciones de los resultados, las intervenciones concomitantes y la distinción

entre el riesgo de presentar un seroma y el riesgo general de complicaciones. Resultados: Un índice de masa corporal más elevado y una mayor disrupción de los tejidos durante la cirugía se asocian con la aparición de seromas en diversas cohortes; por su parte, la contribución de la liposucción varía en función de la disección realizada y el manejo del espacio muerto. Las suturas de tensión progresiva (o suturas de fijación) y la preservación de la fascia de Scarpa cuentan con la evidencia más sólida, aunque la magnitud del efecto depende del diseño del estudio y de la técnica empleada. Un metaanálisis comparativo indicó una razón de riesgo (risk ratio) de 0,34 para el uso de suturas de tensión progresiva frente a los drenajes convencionales; una síntesis de 2026 sobre la preservación de la fascia de Scarpa mostró una asociación combinada similar, fundamentada principalmente en evidencia observacional. El uso de un mayor número de drenajes no ha demostrado una mejora constante en los resultados. Un pequeño ensayo aleatorizado no halló beneficios adicionales en la prevención de seromas mediante el uso de fajas abdominales tras una abdominoplastia con suturas de fijación. El empleo de adhesivos, dispositivos de energía, ácido tranexámico y apósitos de presión negativa requiere una interpretación específica según el resultado analizado. Conclusiones: La prevención debe abordar el espacio muerto, las fuerzas de cizallamiento, el daño tisular y los factores de riesgo propios del paciente. Resulta más justificado establecer un protocolo quirúrgico y de seguimiento reproducible que asumir que un único elemento complementario puede prevenir el seroma en todos los casos.

Palabras clave: Abdominoplastia. Seroma. Suturas de Tensión Progresiva. Suturas de Fijación. Fascia de Scarpa. Complicaciones Postoperatorias.

1 INTRODUCTION

Seroma is an accumulation of fluid in the postoperative tissue plane created during abdominoplasty. Although often manageable, it can require repeated aspirations, prolong recovery, distort contour, contribute to wound problems, and occasionally become chronic or encapsulated. Its clinical importance extends beyond whether a small collection is visible on ultrasound. Prevention should reduce symptomatic collections and interventions while preserving perfusion, contour, and patient safety.[1,2]

A meta-analysis of 143 studies involving 27,834 individuals reported a pooled seroma frequency of 10.9%. That figure is useful as a broad description of the literature, but cannot be treated as a universal benchmark for every technique or practice. The studies differ in patient characteristics, clinical surveillance, ultrasound use, concomitant procedures, and the definition of a seroma. A practice that routinely images asymptomatic patients may report more collections without having more clinically important complications.[3,4]

This review evaluates risk factors and preventive strategies, emphasizing comparative evidence and the separation of mechanistic plausibility from demonstrated clinical benefit. The question is not simply whether drains or a named technique are used, but how the entire operative and postoperative protocol influences fluid formation, dead space, and the threshold for intervention.

2 METHODS

Targeted PubMed searches combined abdominoplasty with seroma, risk factors, prevention, randomized trial, progressive tension sutures, Scarpa fascia, drains, compression, and meta-analysis. Additional searches retrieved foundational comparative studies not captured among recent publications. Sources available through October 24, 2026 were considered, and bibliographic details of all included references were verified in PubMed.

This is a structured narrative review, not a systematic review. There was no registered protocol, independent duplicate screening, formal risk-of-bias scoring, or new quantitative pooling. Randomized and prospective comparative studies were prioritized where available. Retrospective series were interpreted as associations that can reflect patient selection, surgeon experience, and cointerventions. Results from panniculectomy, hernia reconstruction, or flap donor sites were not assumed interchangeable with aesthetic abdominoplasty.

3 MECHANISMS AND OUTCOME DEFINITIONS

Seroma formation is multifactorial. Flap elevation disrupts tissue planes and lymphatic channels, creates an inflammatory wound surface, and leaves a potential space in which fluid can accumulate. Movement between the flap and underlying fascia produces shear, while tissue injury and local exudation contribute to ongoing fluid production. These mechanisms explain why aspiration removes an existing collection but does not necessarily correct the conditions that maintain it.[2,5]

The relative contribution of lymphatic leakage and inflammatory exudate varies, and preservation of a named fascial layer should not be equated automatically with complete preservation of drainage. A small lymphatic imaging study documented changes in superficial abdominal drainage after abdominoplasty, supporting anatomical disruption without proving that a particular preventive technique eliminates its consequences. Clinical outcome data remain necessary to judge benefit.[5]

Definitions should distinguish an asymptomatic ultrasound collection, a palpable clinical seroma, a collection requiring aspiration, and a persistent or recurrent encapsulated cavity. The timing of assessment also matters: early imaging may reveal fluid that would otherwise resolve, while short follow-up can miss delayed recurrence. In the randomized progressive-tension study of Andrades and colleagues, ultrasound detected substantially more collections than clinical examination, illustrating how ascertainment changes reported frequency.[4]

Total drain output, time to drain removal, seroma incidence, aspiration burden, infection, and reoperation should be reported separately. Lower drainage does not by itself prove fewer clinically significant seromas, and a drain-free protocol does not necessarily reduce fluid production. The most informative studies combine standardized surveillance with patient-centered outcomes and explicit intervention criteria.

4 PATIENT RELATED RISK FACTORS

4.1 BODY MASS INDEX AND TISSUE CHARACTERISTICS

Higher body mass index (BMI) is associated with seroma in several cohorts. In a 200-patient retrospective comparison, increasing BMI was independently associated with seroma, with an odds ratio of 1.1 per BMI unit as modeled. The same study reported clinically detected seroma in 16.0% after abdominoplasty alone and 31.2% with concomitant flank liposuction.

These estimates arise from a specific surgical period and protocol and should not be presented as current universal rates.[6]

BMI can correlate with flap thickness, tissue volume, comorbidity, operative complexity, and the extent of dissection. It should inform counseling and optimization rather than act as a solitary binary rule. A prospective study also reported greater complication burden in patients with higher BMI, but the relationship between BMI and each individual complication is less certain than the general association with recovery and wound risk.[7]

4.2 WEIGHT LOSS HISTORY AND NUTRITIONAL STATUS

Post-bariatric and massive-weight-loss patients often require more extensive skin removal and may have nutritional, scar, or tissue-quality considerations. The label post-bariatric does not identify a uniform risk state. Weight stability, protein intake, anemia, deficiencies, metabolic disease, and the planned extent of surgery should be assessed individually. Studies of post-bariatric abdominoplasty identify multiple contributors to complications, but findings for composite morbidity should not be relabeled as independently established seroma predictors.[8,9]

This distinction is important when counseling patients: impaired healing, infection, hematoma, and seroma have overlapping but nonidentical determinants. Optimization of nutrition and comorbidity is clinically reasonable even when its isolated effect on seroma incidence has not been quantified in a randomized trial. A patient-specific plan should avoid promising that weight reduction or a laboratory target alone will eliminate collections.

4.3 SCARS AND PREVIOUS PROCEDURES

A retrospective cohort of 746 patients found an association between previous cesarean delivery and postoperative seroma, with an odds ratio of 1.65 (95% confidence interval, 1.07–2.56). This is an increase in odds, not a directly measured 65% increase in absolute risk. Scarring or altered tissue planes could contribute, but the mechanism remains uncertain and external confirmation is needed.[10]

Prior abdominal operations, liposuction, and contouring procedures should therefore be documented for operative planning. Scar position and perfusion implications may matter more than a simple yes/no history. Smoking and diabetes are important general surgical risk factors, but their association with overall complications should not be converted automatically into a seroma-specific effect size without appropriate analysis.[1]

4.4 OPERATIVE FACTORS AND THE LIPOSUCTION QUESTION

Wide undermining increases the exposed tissue plane and potential dead space. Greater flap mobility may contribute to shear, while extensive tissue trauma can increase exudation. These mechanisms favor limited or selective undermining when compatible with the reconstructive objective, but comparative studies often alter several elements simultaneously. Consequently, an observed improvement cannot always be attributed to dissection extent alone.[2]

The contribution of concomitant liposuction is inconsistent across eras and protocols. Older retrospective studies associated flank liposuction with increased seroma; in the 200-patient cohort, the adjusted odds ratio was 3.3. Another early series also examined obesity and flank liposuction as relevant contributors. These findings are important but do not establish that every modern lipoabdominoplasty has higher risk than abdominoplasty alone.[6,11]

In contrast, a 619-patient retrospective cohort including 299 drainless progressive-tension procedures found no significant increase in seroma when liposuction was added within the progressive-tension group. The overall seroma frequency in that group was 2.6%. The study supports the view that liposuction interacts with flap handling and dead-space closure, but does not prove liposuction is protective. Differences in patient selection, aspiration volume, dissection, and surgeon experience remain potential confounders.[12]

Thermal injury is another plausible contributor, but its clinical effect depends on the device, settings, hemostatic practice, and comparator. A randomized trial of 102 patients found no significant difference in clinically detected seroma between handheld coagulation electrocautery and sharp dissection: 17.2% versus 20.1%. Drains were removed at 48 hours regardless of output. Thus, a general statement that electrocautery inevitably increases seroma is stronger than the randomized evidence supports.[13]

4.5 PROGRESSIVE TENSION AND QUILTING SUTURES

Progressive tension sutures and quilting sutures attach the abdominal flap to the deeper plane, reduce available dead space, distribute advancement forces, and limit shear. Techniques vary in suture material, number, placement, and whether fixation is interrupted or continuous. The broad principle has more evidence than any claim that one exact suture pattern is universally optimal.[2,14]

In the randomized study by Andrades and colleagues, 60 women were assigned to no drains/no progressive tension sutures, progressive tension sutures alone, drains alone, or both. The untreated control group was interrupted after larger collections and greater intervention requirements. Progressive tension suturing reduced drain output and increased operating time, but clinical and ultrasound seroma frequency did not differ significantly among the active strategies. The small groups and differing collection definitions limit precise ranking.[4]

A more recent comparative meta-analysis found a lower seroma rate with progressive tension suturing than conventional drains, with a risk ratio of 0.34 (95% confidence interval, 0.15–0.76). The underlying studies included substantial observational evidence and heterogeneous techniques. The pooled relative effect is therefore more defensible than a universal absolute risk reduction or a claim that drains are unnecessary in every patient.[15]

The 2024 review of higher-level preventive evidence also found progressive-tension and quilting approaches to have the largest supportive evidence base. A separate 451-case practice series documented reduced seroma after adoption of a drainless progressive-tension protocol, but its historical comparison cannot separate the sutures from accumulated experience and other practice changes. Taken together, the findings support deliberate flap fixation as a useful prevention strategy.[2,16]

4.6 PRESERVATION OF SCARPA FASCIA

Preservation of infraumbilical Scarpa fascia and associated deep tissue aims to limit disruption, reduce the raw surface, and preserve aspects of local drainage. The technique must be balanced against contouring requirements and does not remove the need for hemostasis or management of the remaining potential space. The preserved tissue plane and cointerventions should be described explicitly in research reports.[17,18]

A randomized trial of 160 women compared conventional full abdominoplasty with preservation of Scarpa fascia and the infraumbilical deep fat compartment. The preservation group had lower total drain output, earlier drain removal, and a reported 86.7% relative reduction in seroma rate, without a significant difference in assessed aesthetic outcome. The relative reduction should not be misread as an 86.7 percentage-point absolute benefit.[18]

A 2026 meta-analysis included eleven studies and found a pooled seroma risk ratio of 0.34 (95% confidence interval, 0.21–0.53) in the ten studies contributing to that outcome. Drain output and duration also favored preservation, but those secondary outcomes had

substantial heterogeneity. Importantly, the overall findings were predominantly driven by observational data, while the randomized subgroup was not statistically significant. A nonsignificant subgroup does not prove absence of benefit, but it limits certainty about the pooled magnitude.[19]

Earlier systematic reviews similarly favored preservation, although technique definitions and study inclusion differed. The appropriate conclusion is that Scarpa-preserving dissection is a supported option, not a guarantee against seroma or a mandatory technique for every abdominal contour. Preservation and progressive tension fixation may be complementary, but combined benefit cannot be assumed to equal the sum of their separate effect sizes.[20,21]

4.7 DRAINS AND POSTOPERATIVE COMPRESSION

Closed-suction drains evacuate fluid but do not themselves eliminate shear or the source of exudation. They remain appropriate in many protocols, especially when extensive potential space persists or flap fixation is not used. Drain-free surgery is best understood as a complete operative strategy with follow-up, rather than simply omission of drains from an otherwise unchanged procedure.[2,22]

Evidence does not consistently show that increasing drain number reduces seroma. In the 2024 higher-level evidence review, increasing the number of drains was not supported as an effective independent preventive measure. Drain duration should consider the operative technique, output trend, wound condition, and practical risks; neither a fixed postoperative day nor a single volume threshold is universally validated across all procedures.[2,23]

A randomized trial involving 34 women undergoing quilting-suture abdominoplasty found no significant reduction in ultrasound seroma volume from wearing an abdominal binder. This study does not answer every question about comfort or support, but it challenges the assumption that compression is a proven substitute for operative dead-space control. Excessive compression should also be avoided when it impairs breathing, comfort, skin integrity, or circulation.[24]

4.8 ADJUNCTS AND THE LIMITS OF COMPARATIVE EVIDENCE

Tissue adhesives and fibrin sealants have shown benefit in some studies, but formulations, application, operative techniques, and endpoint definitions vary. Reviews

suggest potential value, while the evidence does not establish that every adhesive provides the same effect. Cost, technique, and whether the objective is reduced drainage or fewer aspirations should be considered before adopting an adjunct.[2,21]

A 2026 network meta-analysis compared several preventive approaches and reported a favorable association for Scarpa preservation against a two-drain comparator. Network rankings depend on the comparability of patients and cointerventions across studies; they should not be interpreted as definitive head-to-head proof for all available combinations. Direct adequately powered comparisons remain necessary.[25]

Tranexamic acid, alternative dissection devices, and incisional negative-pressure therapy may affect bleeding, drainage, or wound complications, but those outcomes are not interchangeable with clinically important seroma. Current studies should be interpreted according to their specific operation and endpoint. Routine steroid injection or other pharmacological attempts to suppress fluid production cannot be recommended solely from a mechanistic rationale or a small selected study.[26,27,28]

Table 1

Evidence supporting preventive strategies after abdominoplasty

Strategy	Evidence	Potential benefit	Qualification
Progressive tension or quilting sutures	Randomized studies, comparative cohorts, and meta-analysis. [4,15]	Comparative pooled RR 0.34 (95% CI 0.15–0.76) versus conventional drains; reduces dead space and shear.	Techniques and cointerventions vary; pooled evidence includes substantial observational data.
Scarpa fascia preservation	Randomized 160-patient trial and 2026 synthesis. [18,19]	Lower seroma and drainage in several studies; pooled seroma RR 0.34 (95% CI 0.21–0.53).	Observational studies drive the pooled association; randomized subgroup estimates are less certain.
Closed-suction drains	Comparative literature and selected randomized data. [2,22]	Evacuates fluid within a broader operative protocol.	More drains have not consistently reduced seroma. Drain-free results should not be equated with simple omission of drains.
Limited tissue disruption and dissection choice	Mechanistic rationale and heterogeneous comparative evidence. [2,13]	May reduce raw surface, trauma, or shear when compatible with the operation.	A 102-patient RCT did not show a significant seroma difference between sharp and coagulation electrocautery dissection.

Strategy	Evidence	Potential benefit	Qualification
Abdominal binder	RCT of 34 women after quilting-suture abdominoplasty. [24]	May offer support or comfort in selected patients.	No significant reduction in ultrasound seroma volume; comfort was not the same endpoint as seroma prevention.
Adhesives or fibrin sealants	Selected controlled studies and reviews. [2,21]	Possible reduction in collections or drainage.	Formulation, application, cost, and endpoints differ; not a proven substitute for dead-space management.
Tranexamic acid or incisional negative pressure	Emerging evidence on bleeding, drainage, and wound outcomes. [26,27]	May improve selected procedure-specific outcomes.	Reduced bleeding or drainage does not automatically establish fewer clinically important seromas.

CI, confidence interval; RCT, randomized controlled trial; RR, risk ratio. Relative effects are not absolute percentage-point reductions. Preventive measures are often applied as a bundle, limiting attribution to any single component

4.9 A PRACTICAL PREVENTION AND FOLLOW UP STRATEGY

Preoperative planning should document BMI, weight stability, nutritional and metabolic concerns, smoking, prior scars, previous body contouring, and the proposed extent of surgery. Counseling should explain that seroma can occur despite preventive measures and that follow-up may involve imaging or aspiration. These measures help align expectations and improve safety even where the isolated effect on seroma is uncertain.

Intraoperatively, the strongest practical principles are to use careful tissue handling, achieve hemostasis, limit unnecessary disruption, and deliberately address dead space and shear. Selection among Scarpa-preserving dissection, progressive tension fixation, drains, or combinations should reflect anatomy, surgeon experience, and the available comparative evidence. Thromboprophylaxis decisions must remain based on thromboembolic and bleeding assessment; fear of seroma alone does not justify withholding indicated prophylaxis.

Postoperative surveillance should distinguish normal edema from a collection and assess wound tension, pain, erythema, fever, or persistent drainage. Ultrasound is useful when examination is uncertain, to characterize a collection, or to guide treatment. Not every small asymptomatic collection requires intervention. A clinically significant collection may require sterile aspiration, while suspicious infection requires appropriate investigation and treatment.[1]

Repeatedly recurrent collections should prompt reassessment of dead space and the possibility of an established capsule. Chronic encapsulated seroma may require surgical

treatment, but routine preventive capsulectomy is not relevant to primary uncomplicated abdominoplasty. Research reports should record aspiration number, total aspirated volume, infection, recurrence, and reoperation rather than simply count any ultrasound fluid as a complication.[29]

5 LIMITATIONS AND RESEARCH PRIORITIES

Most comparisons evaluate bundles of operative changes, making attribution difficult. Surgeon learning curves, ultrasound surveillance, drain-removal policies, and aspiration thresholds can change alongside the intervention. Retrospective differences in BMI, weight loss, liposuction volume, and the extent of surgery further complicate interpretation. Meta-analyses often reuse overlapping primary studies and should not be counted as multiple independent confirmations.

Future trials should standardize clinically meaningful seroma definitions, follow-up timing, and intervention criteria. They should report baseline risk, absolute event rates, drainage, aspiration burden, comfort, contour, cost, and adverse outcomes separately. Factorial or carefully controlled comparative designs could clarify whether preservation and fixation add independent benefit and which patients can reliably avoid drains.

6 CONCLUSION

Seroma prevention after abdominoplasty is best approached through patient assessment and deliberate control of tissue injury, dead space, and shear. Progressive tension or quilting sutures and Scarpa fascia preservation have the strongest supportive evidence, but certainty varies and absolute benefits depend on the operative setting. Drain number, compression, and newer adjuncts should not be assumed effective without outcome-specific evidence. Standardized follow-up and consistent reporting of clinically important collections are essential for both patient care and future comparative research.

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