SYSTEMATIC REVIEW

Two walls versus three wall orbital decompression for thyroid eye disease: A systematic review and meta-analysis

Haissan Iftikhar[1], Muhammad Hammad Deewani[2], Syed Akbar Abbas[3], Zohra Lassi[4], Jai Das[5], Shahzada Ahmed[6]

Abstract

Objective: To assess whether three-wall surgical orbital decompression confers any benefit over two-wall surgical orbital decompression in terms of decrease in proptosis and new-onset diplopia.

Method: The systematic review was conducted in 2020, and comprised literature search on Elton B. Stephens Co, Cumulative Index to Nursing and Allied Health Literature, Wiley Cochrane Library, Web of Science and PubMed databases for studies published from 1948 to 2019 that compared two-wall (medial and inferior) endoscopic decompressions with three-wall decompression. Relevant data was extracted from the literature, and was subjected to qualitative assessment using Cochrane Effective Practice and Organisation of Care criterion by two researchers independently.

Results: Of the 111 studies identified, 2(1.8%) met the eligibility criteria, with a total of 72 patients. Of them, 37(51.4%) patients had undergone two-wall decompression and 35(48.6%) had undergone three-wall decompression. There was significant difference seen with change in proptosis in the groups in favour of three-wall decompression (p=0.0003). New onset diplopia showed a greater trend towards two-wall decompression, but not significantly (p=0.39).

Conclusion: Limited evidence was found to determine if three-wall orbital decompression is superior to two-wall orbital decompression for thyroid eye disease.

Keywords: Thyroid-associated ophthalmopathies, Thyroid eye disease, Grave's ophthalmopathy. (JPMA 75: 777; 2025)

DOI: https://doi.org/10.47391/JPMA.10271

Introduction

Thyroid eye disease, or thyroid ophthalmopathy, is an autoimmune inflammatory disorder affecting the eye and orbital tissues. It is one of the most common extrathyroidal manifestations of Graves' disease, and it is also associated with other thyroid diseases, like Hashimoto's thyroiditis.[1] Almost half of the patients with Graves' disease develop thyroid ophthalmopathy in varying intensity,[2] which is secondary to glycosaminoglycan deposition in the extraocular muscles. Most patients suffer from a mild form of illness, with only one-third of affected individuals developing severe ophthalmopathy resulting in compressive neuropathy and exposure keratopathy, and requiring surgical decompression of the orbit.

Various techniques for orbital decompression have been used, differing in incision and approaches used (open or endoscopic) and depending on which and how many orbital walls are decompressed. Outcomes, as measured by improvement in proptosis, visual acuity (VA) and intraocular pressure (IOP), are fairly similar across various techniques. Persistent or secondary diplopia remains a significant problem with a reported incidence ranging from 20% to 60%.[3-6]

Endoscopic orbital decompression for thyroid ophthalmopathy has been accepted to be a safe, minimally invasive and a very effective method for reducing proptosis.[7] Kronlein, in 1899, was the first to describe removal of tumour via lateral orbital access, while Dollinger, in 1911, decompressed the orbit for thyroid-related ophthalmopathy.[8] In 1990, Kennedy et al., and, in 1991, Michel et al. reported a series of intranasal endoscopic decompressions with similar improvements in Hertel measurements, with less morbidity than previous large series. Metson et al. and Lund et al. later reported complete endoscopic decompressions with similar results.[9-12]

Numerous variations exist with respect to endoscopic orbital decompression,[3-5] varying in orbital walls decompressed, including two-wall decompression with patients undergoing decompression of only the medial wall and the orbital floor endoscopically, while others include simultaneous decompression of the lateral orbital wall along with the orbital floor and medial wall either via endoscopic or open approaches, called the three-wall orbital decompression. The selection of surgical technique has largely been based on surgeons' experience or institutional preferences rather than on specific patient

[1]Department of Rhinology and Anterior Skull Base Surgery, University Hospital Birmingham, Birmingham, England; [2,3]Department of Surgery, Aga Khan University Hospital, Karachi, Pakistan; [4]Adelaide Medical School, Adelaide, Australia; [5]Department of Public Health and Development, Aga Khan University Hospital, Karachi, Pakistan; [6]Department of Rhinology, Queen Elizabeth Hospital, Birmingham, England.

Correspondence: Syed Akbar Abbas. e-mail: akbar.abbas@aku.edu
ORCID ID: 0000-0003-3911-1632

Submission completed: 09-07-2023 **1st Revision received:** 30-01-2024
Acceptance: 12-02-2025 **Last Revision received:** 11-02-2025

characteristics. Also, a third lateral wall decompression requires greater expertise with or without an external incision and an increased operative time. Therefore, the current systematic review was planned to assess whether three-wall surgical orbital decompression confers any benefit over two-wall surgical orbital decompression in terms of decrease in proptosis and new-onset diplopia.

Materials and Methods

The systematic review was conducted in 2020, following the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines, and comprised literature search on Elton B. Stephens Co (EVSCO), Cumulative Index to Nursing and Allied Health Literature (CINAHL plus), Wiley Cochrane Library, Web of Science and PubMed databases for studies published from 1948 to 2019 that compared two-wall (medial and inferior) endoscopic decompressions with three-wall decompression. The key words used in the search were thyroid ophthalmopathy, thyroid ophthalmopathies, thyroid eye disease, dysthyroid optic neuropathy, two-wall orbital decompression surgery, two-wall decompression surgery, three-wall orbital decompression surgery, and three-wall orbital decompression surgery. The key words were used with Boolean operators.

The studies included were those comprising adult patients with thyroid eye disease requiring orbital decompression, and comparing two-wall endonasal decompression with three-wall decompression. Studies that had paediatric subjects, and those using external approaches were excluded. Also excluded were the studies which either compared two-wall (lateral with medial) balanced decompression with three-wall (lateral, inferior and medial) decompressions. The studies that had no comparison arm and simply reported outcomes using either of the above operative techniques to decompress an orbit were also excluded.

The population of interest was adult patients with thyroid eye disease refractory to medical therapy. Intervention was taken as three-wall orbital decompression in which medial and inferior orbital walls were decompressed endonasally, whereas the lateral wall was decompressed with either an external or lateral canthotomy incision. The second intervention was in patients who underwent endoscopic two-wall decompressions. The two walls were medial and inferior or floor. The primary outcomes were change in proptosis, and the secondary outcome was new onset of diplopia.

Data was extracted using a predesigned proforma.

Two independent reviewers screened the titles and abstracts. After removal of duplicates, full text of the included articles were reviewed. In case of any disagreement, the third reviewer was taken on board.

Meta-analysis was performed for mean change in proptosis for both interventions. Forest plots were generated for new-onset diplopia between the groups.

Qualitative assessment of the studies was conducted using the Cochrane's Effective Practise and Organisation of Care (EPOC) tool. This was again performed independently by two reviewers, and any disagreement was resolved with discussion. A total of nine components were reported as high, low or unclear risk of bias.

Results

Of the 111 studies identified, 2(1.8%) met the eligibility criteria (Figure 1).[7,13] Both the studies had a retrospective design, and had a total of 72 patients; 37(51.4%) in the two-wall decompression group, and 35(48.6%) in the three-wall decompression group (Table 1).

The 2016 study by Finn et al. in the United States included a total of 26(36.1%) patients, and orbital decompression was performed on 45 eyes.[7] Two-wall decompression was performed on 11(24.4%) orbits, whereas three-wall decompression was performed on 34(75.5%) orbits. Juniat et al, in 2019 in Australia, included a total of 46 patients.[13]

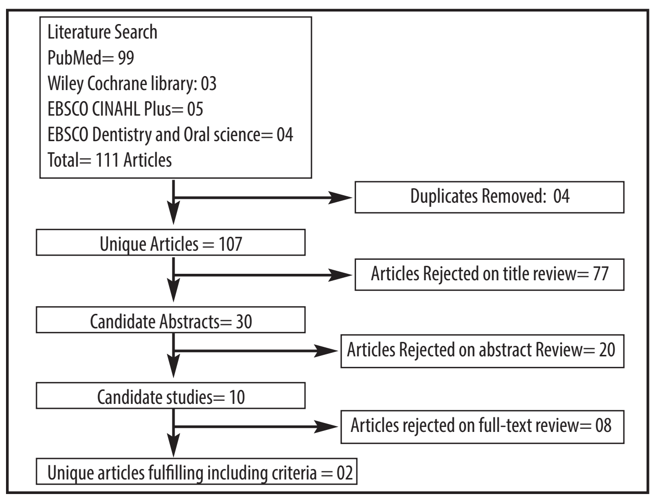

Figure-1: Preferred Reporting Items for Systematic review and Meta-analysis (PRISMA) flow diagram.[23]

Table-1: Characteristics of the studies analysed.

Authors	Year of publication	Country of publication	Sample size	Subset undergoing 2 wall decompression	Subset undergoing 3 wall decompression*
Finn et al[7]	2016	United States	26	06	20
Juniat et al[13]	2019	Australia	46	31	15

*Juniat et al, subgroup data on two walls versus three wall orbital decompression

Table-2: Change in proptosis and the rate of diplopia.

Authors	Two-wall decompression		Three-wall decompression		*p*-value for change in proptosis
	Change in proptosis (mm)	**Rate of new onset diplopia** (%)	**Change in proptosis** (mm)	**Rate of new onset diplopia** (%)	
Finn et al*[7]	2.58	16%	4.61	5%	0.012
Juniat et al[13]	3.9 + 0.9	3.2%	7.6 + 2.1	0	-

* Standard deviation not reported along with mean change in proptosis

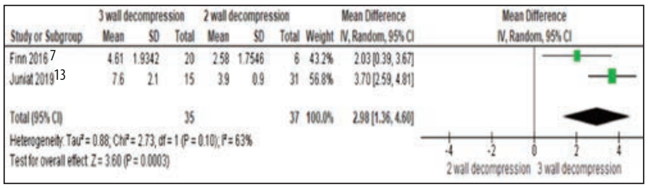

Figure-2: Forest plot for mean decrease in proptosis (mm) following two-wall and three-wall orbital decompression.

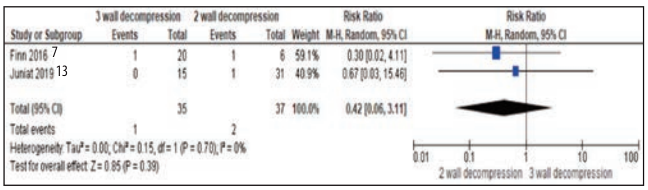

Figure-3: Forest plot for the rate of new-onset diplopia following two-wall and three-wall orbital decompression.

Table-3: Risk of bias.

Risk of bias criteria	Juniat et al	Finn et al
Random sequence generation	Unclear risk	Unclear risk
Allocation concealment	Unclear risk	Unclear risk
Baseline outcome measurement	Unclear risk	Unclear risk
Baseline characteristics	Unclear risk	Unclear risk
Incomplete outcome data	Low risk	Low risk
Knowledge of allocated interventions adequately prevented during the study	Unclear risk	Unclear risk
Protection against contamination	Not applicable	Not applicable
Selective outcome reporting	Low risk	Low risk
Other bias	Low risk	Low risk

Quality assessment of included studies using Cochrane Effective Practice and Organization of Care (EPOC) tool.[22]

Two-wall decompression was performed on 31(67.4%) orbits and three-wall decompression on 15(32.6%) orbits.

The exact time of measuring proptosis after decompression was not stated in either of the studies.

Finn et al. reported a change of 2.58mm for patients who underwent two-wall decompression compared to 4.61mm for those who underwent three-wall decompression.[7] Of the 70 eyes operated, Juniat et al, reported a mean decrease of 3.09±0.9mm for those who underwent two-wall decompression compared to 7.6±2.1mm for patients who underwent three-wall decompression (Table 2).[13]

The mean difference in proptosis in the Finn et al.[7] study was 2.03mm (95% confidence interval [CI]: 0.39–3.67) favouring three-wall decompression. The corresponding value in the Juniat et al. study was 3.70mm (95% CI: 2.59–4.81) favouring three-wall decompression. The overall mean difference was 2.98mm (95% CI: 1.36-4.60) favouring three-wall decompression which was significant (Z=3.60, p=0.0003). The results were reported using random effect meta-analysis due to small sample size and heterogeneous population (Figure 2).

Finn et al.[7] reported an overall incidence of post-operative new-onset diplopia of 20% in favour of the three-wall group. Juniat et al.[13] reported 1(3,2%) patient with new onset diplopia in patients who underwent endoscopic two-wall decompression, and none in those who underwent three-wall decompression.

The risk ratio of developing diplopia in the Finn et al.[7] study was 0.30 (95% CI: 0.02-4.11) favouring two-wall decompression. The risk ratio in the Juniat et al.[13] study was 0.67 (95% CI: 0.03-15.46) favouring two-wall decompression. The overall risk ratio was 0.42 (95% CI: 0.06-3.11) which was not significant (Z=0.85, p=0.39) using random effect meta-analysis (Figure 3).

In terms of qualitative analysis, no item in the two studies carried high risk. The overall quality of evidence was graded as having an unclear risk of bias. Analysis of baseline outcome and baseline characteristics would have improved the quality of evidence. Even though intervention was performed in both arms, it was difficult to determine if there was a significant difference between the two groups. Similarly, the absence of specific description of randomisation and allocation concealment led to an unclear risk of bias (Table 3).

Discussion

Trans-nasal endoscopic orbital decompression was first introduced by Kennedy et al, in 1990.[9] Orbital decompression is performed by both otolaryngologists and ophthalmologists.[14] In the latter case, either an external incision or a trans-conjunctival incision is used to drill out bony orbital walls.[15] With advances in the understanding of nasal and skull base anatomy along with improvement in endoscopic optics, surgeons have ventured far to perform procedures that were previously considered inoperable. There has been a recent gain in popularity of endoscopic orbital decompressions as can be seen by the number of papers being published on the subject.[16,17]

Juniat et al.[13] reported a 3.09mm reduction in proptosis and Finn et al.[7] reported a 2.58mm change with two-wall decompression.[7,13] Similarly, Wright et al. reported 3.6mm change in proptosis operating on 21 orbits.[18] Stiglmayer et al. reported a mean decrease of 4.6mm on decompressing 32 orbits.[19] Historically, trans-antral route for orbital decompression was also popular, and was a mainstream procedure for patients with Grave's ophthalmopathy. Garrity et al. reported on a large cohort of two=wall trans-antral decompression on 428 orbits with a mean reduction of 4.7mm.[20]

In three-wall decompressions, Juniat et al. reported 7.6±2.1mm mean change in proptosis, whereas Finn et al. reported 4.61mm decrease in proptosis.[7,13] Three-wall decompressions previously had not gained much popularity, and, therefore, relevant findings been reported scarcely in the literature. Korkmaz et al. reported a mean change of 7.2mm, but they used lateral canthotomy for the lateral wall and trans-caruncular approach for the medial wall.[15] There has been significant literature published on balanced decompression,[14,16,17] meaning medial and lateral wall decompression, excluding the inferior wall. This essentially reduces the changes of globe transposition and reduces the risk of post-operative diplopia.[21] However, the caveat is that the reduction in proptosis is not as considerable as three-wall decompression.[15]

The current review highlights a few key findings. There was greater reduction in proptosis with three-wall decompression, and there was no significant difference in new-onset diplopia after either intervention even though the data showed a trend favourable to two-wall decompression. The current review did not conduct a proportion meta-analysis because the idea was to compare both the interventions on the same cohort of patients that met the specific eligibility criteria. Furthermore, as there is more literature on two-wall decompressions (balanced, endoscopic and external) compared to three=wall decompression, it would have led to skewed results and biased estimates. The current review was limited in the number of papers available. This was because of the heterogeneity amongst the procedures performed for orbital decompression for thyroid eye disease, which was a key finding of the review. It seems that even though orbital decompression surgically has been around for decades, there is lack of consensus on the optimum surgical approach for such patients. Finn et al.[7] did not report standard deviations with their mean values and reported p=0.012 for change in proptosis comparing two-wall and three-wall decompressions. Other limitations were owing to a significant heterogeneity that was noticed in literature regarding different techniques of orbital decompression. The inclusion criterion, therefore, was kept limited to the studies that had a comparison group. Finally, the protocol of the systematic review was not registered with the International Prospective Register of Systematic Reviews (PROSPERO) or any other international database.

In the light of the findings, the need for prospective randomised trials with stringent eligibility criteria and uniformity of operative procedures is clear. There is also a need for guidelines on the surgical aspect of orbital decompressions, and training in endoscopic endonasal orbital decompressions.

Conclusion

Limited evidence was found to determine if three-wall orbital decompression was superior to two-wall orbital decompression for thyroid eye disease. There is a need for prospective randomised trials to accurately determine the superiority of either intervention.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

References

1. Subekti I, Soewondo P, Soebardi S, Darmowidjojo B, Harbuwono DS, Purnamasari D, et al. Practical Guidelines Management of Graves Ophthalmopathy. Acta Med Indones 2019;51:364-71.
2. Menconi F, Marcocci C, Marinò M. Diagnosis and classification of Graves' disease. Autoimmun Rev 2014;13:398-402. doi: 10.1016/j.autrev.2014.01.013.
3. Gulati S, Ueland HO, Haugen OH, Danielsen A, Rødahl E. Long-term follow-up of patients with thyroid eye disease treated with endoscopic orbital decompression. Acta Ophthalmol 2015;93:178-83. doi: 10.1111/aos.12469.
4. Leong SC, Karkos PD, Macewen CJ, White PS. A systematic review of outcomes following surgical decompression for dysthyroid orbitopathy. Laryngoscope 2009;119:1106-15. doi: 10.1002/lary.20213.
5. Malik R, Cormack G, MacEwen C, White P. Endoscopic orbital decompression for dyscosmetic thyroid eye disease. J Laryngol Otol 2008;122:593-7. doi: 10.1017/S0022215107009838.
6. Millar MJ, Maloof AJ. The application of stereotactic navigation surgery to orbital decompression for thyroid-associated orbitopathy. Eye (Lond) 2009;23:1565-71. doi: 10.1038/eye.2009.24.
7. Finn AP, Bleier B, Cestari DM, Kazlas MA, Dagi LR, Lefebvre DR, et al. Retrospective Review of Orbital Decompression for Thyroid Orbitopathy with Endoscopic Preservation of the Inferomedial Orbital Bone Strut. Ophthalmic Plast Reconstr Surg 2017;33:334-9. doi: 10.1097/IOP.0000000000000782.
8. Alper MG. Pioneers in the history of orbital decompression for Graves' ophthalmopathy. R.U. Kroenlein (1847-1910), O. Hirsch (1877-1965) and H.C. Naffziger (1884-1961). Doc Ophthalmol 1995;89:163-71. doi: 10.1007/BF01203409.
9. Kennedy DW, Goodstein ML, Miller NR, Zinreich SJ. Endoscopic transnasal orbital decompression. Arch Otolaryngol Head Neck Surg 1990;116:275-82. doi: 10.1001/archotol.1990.01870030039006.
10. Lund VJ, Larkin G, Fells P, Adams G. Orbital decompression for thyroid eye disease: a comparison of external and endoscopic techniques. J Laryngol Otol 1997;111:1051-5. doi: 10.1017/s0022215100139313.

11. Metson R, Shore JW, Gliklich RE, Dallow RL. Endoscopic orbital decompression under local anesthesia. Otolaryngol Head Neck Surg 1995;113:661-7. doi: 10.1016/S0194-59989570001-3.
12. Michel O, Bresgen K, Rüssmann W, Thumfart WF, Stennert E. Endoscopically-controlled endonasal orbital decompression in malignant exophthalmos. Laryngorhinootologie 1991;70:656-62. doi: 10.1055/s-2007-998119.
13. Juniat V, Abbeel L, McGilligan JA, Curragh D, Selva D, Rajak S. Endoscopic Orbital Decompression by Oculoplastic Surgeons for Proptosis in Thyroid Eye Disease. Ophthalmic Plast Reconstr Surg 2019;35:590-3. doi: 10.1097/IOP.0000000000001406.
14. Shepard KG, Levin PS, Terris DJ. Balanced orbital decompression for Graves' ophthalmopathy. Laryngoscope 1998;108:1648-53. doi: 10.1097/00005537-199811000-00011.
15. Korkmaz S, Konuk O. Surgical Treatment of Dysthyroid Optic Neuropathy: Long-Term Visual Outcomes with Comparison of 2-Wall versus 3-Wall Orbital Decompression. Curr Eye Res 2016;41:159-64. doi: 10.3109/02713683.2015.1008641.
16. Graham SM, Brown CL, Carter KD, Song A, Nerad JA. Medial and lateral orbital wall surgery for balanced decompression in thyroid eye disease. Laryngoscope 2003;113:1206-9. doi: 10.1097/00005537-200307000-00017.
17. Leone CR Jr, Piest KL, Newman RJ. Medial and lateral wall decompression for thyroid ophthalmopathy. Am J Ophthalmol 1989;108:160-6. doi: 10.1016/0002-9394(89)90011-1.
18. Wright ED, Davidson J, Codere F, Desrosiers M. Endoscopic orbital decompression with preservation of an inferomedial bony strut: minimization of postoperative diplopia. J Otolaryngol 1999;28:252-6.
19. Stiglmayer N, Mladina R, Tomić M, Tojagić M, Juri J, Bubas N, et al. Endonasal endoscopic orbital decompression in patients with Graves' ophthalmopathy. Croat Med J 2004;45:318-22.
20. Garrity JA, Fatourechi V, Bergstralh EJ, Bartley GB, Beatty CW, DeSanto LW, et al. Results of transantral orbital decompression in 428 patients with severe Graves' ophthalmopathy. Am J Ophthalmol 1993;116: 533-47. doi: 10.1016/s0002-9394(14)73194-0.
21. Rootman J, Stewart B, Goldberg RA, Koltai PJ. Orbital Surgery--A Conceptual Approach. Int J Pediatr Otorhinolaryngol 1996;3:277-8.
22. Cochrane Effective Practice and Organisation of Care (EPOC). EPOC Resources for review authors. [Online] 2017 [Cited 2025 April 04]. Available from URL: https://epoc.cochrane.org/resources/epoc-resources-review-authors
23. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.

Author Contribution:
HI: Concept, design and analysis.
MHD: Drafting and interpretation.
SAA: Revision.
ZL: Data interpretation.
JD: Data analysis.
SA: Final approval.