

Esophageal Perforation Following Anterior Cervical spine surgery: A Systematic Review of the Literature

Sameer H. Halani, M.S.
Jonathan Riley, M.D., M.S.
Griffin R. Baum, M.D.
Daniel Refai, MD
Faiz U. Ahmad, M.D., M.Ch.

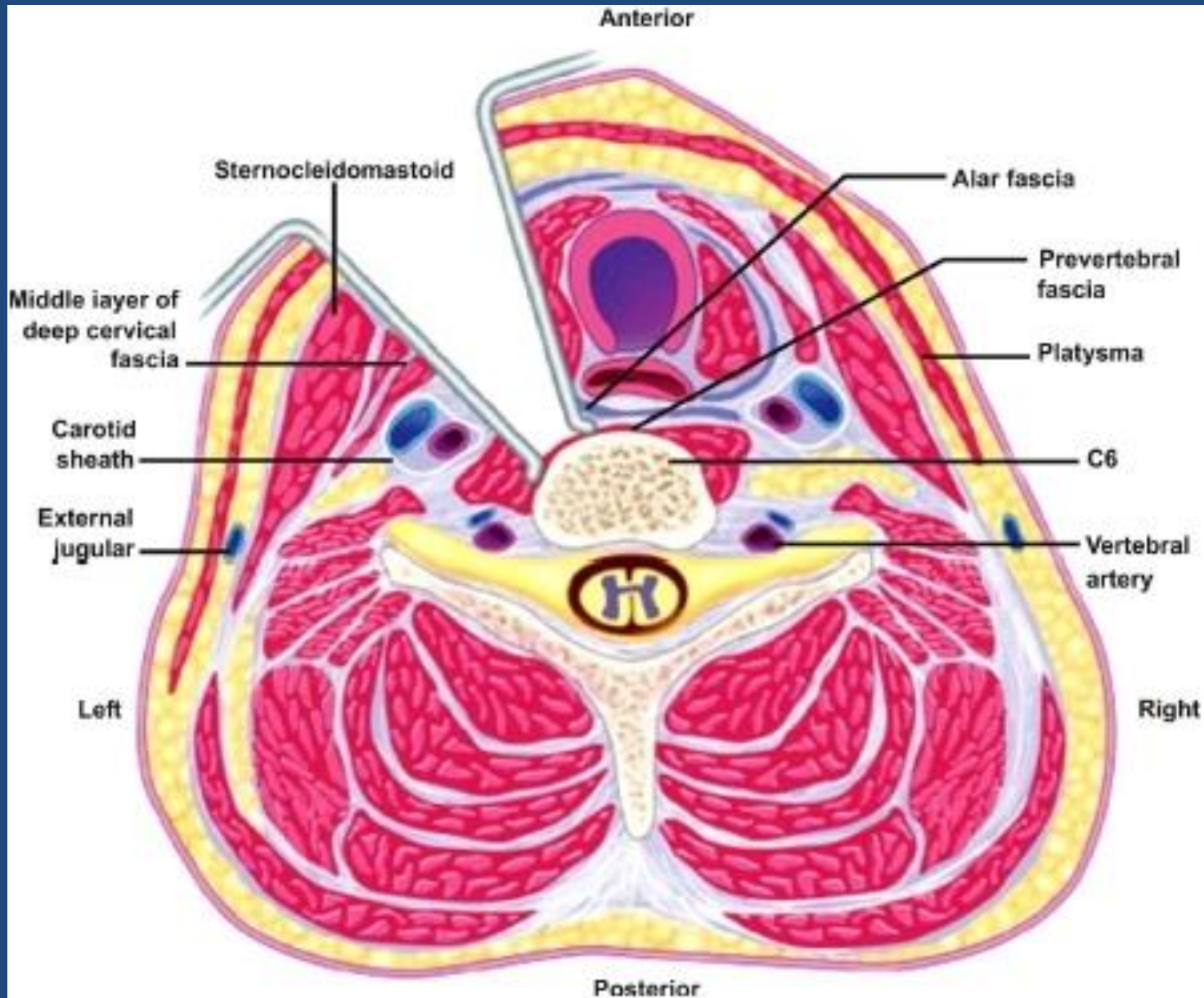
Department of Neurosurgery
Emory University School of Medicine

Learning Objectives

By the end of this presentation, learners should be able to:

- 1.) Develop an understanding of etiology of esophageal perforations in anterior cervical spine surgery
- 2.) Identify the prognosis, outcomes, and methods of repair of esophageal perforations
- 3.) Appreciate the clinical manifestations of esophageal perforation in the post-operative period

Anterior Approach to the Cervical Spine



Source: Palumbo, M. A., et al. (2012). "Airway compromise due to wound hematoma following anterior cervical spine surgery." [Open Orthop J 6: 108-113.](#)

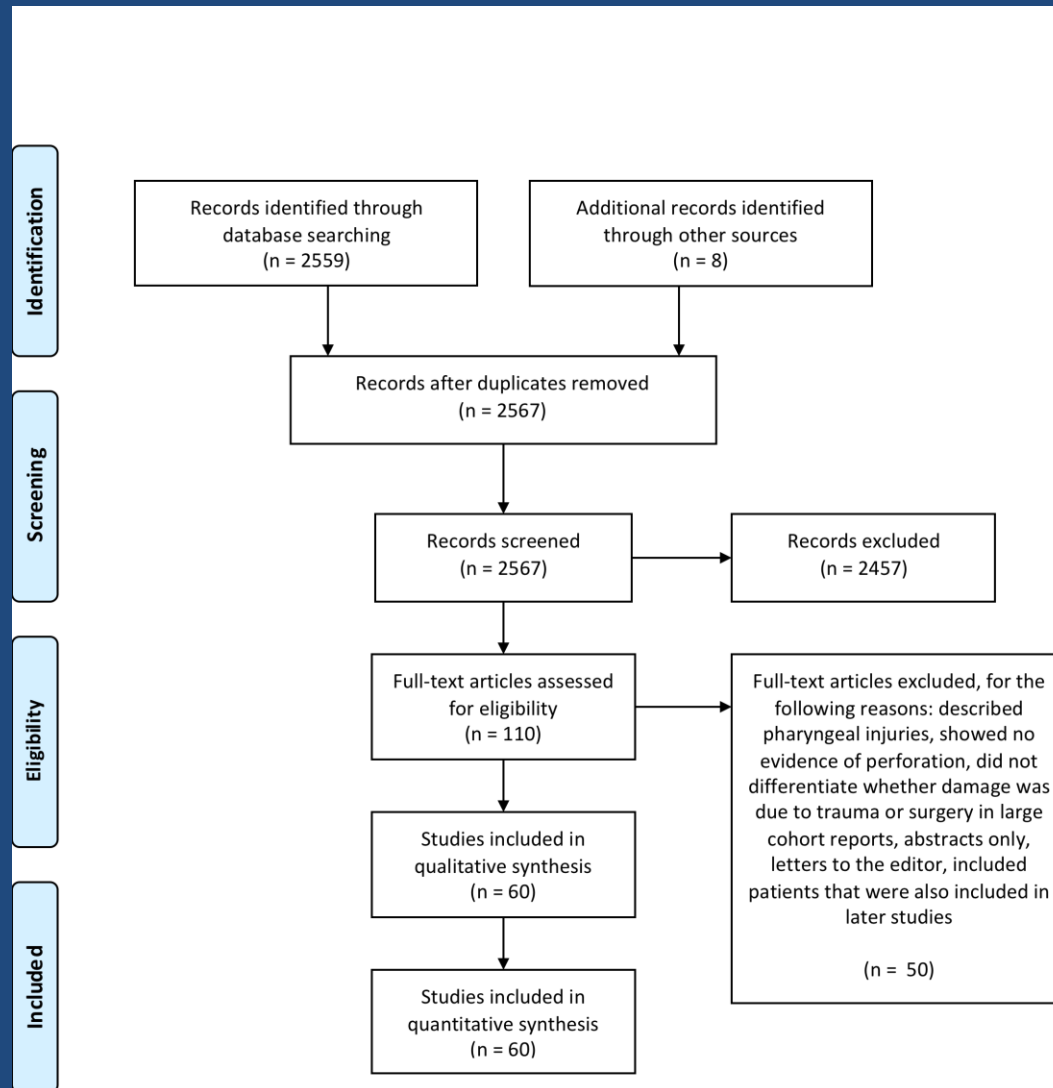


Source: Google Images
(<http://espine.com/wp-content/uploads/2012/07/acdf-2levelgl.jpg>)

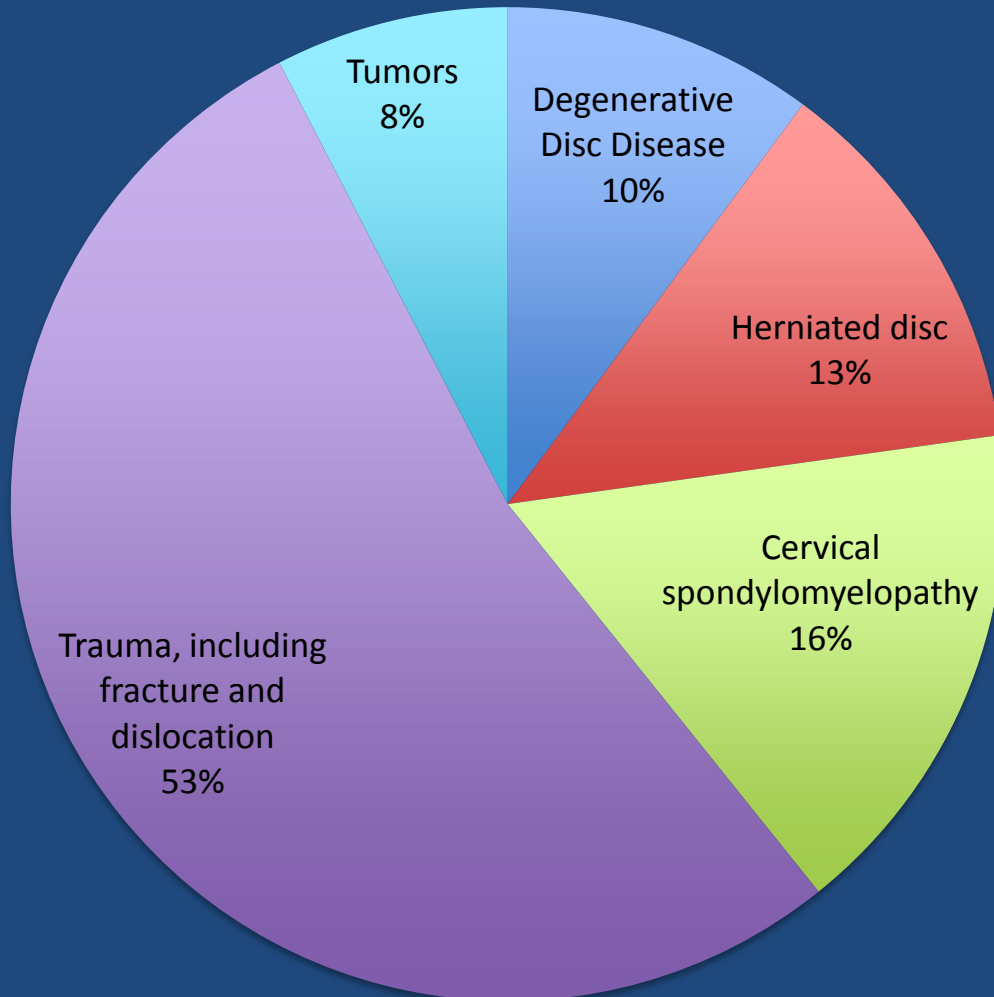
Methods

- PubMed database was searched using the following terms and parameters:
 - Full texts available
 - Published between January 1980 to Present
 - Last search performed on March 30th, 2015
 - “anterior cervical spine surgery” and
 - ‘esophageal’
 - ‘esophagus’
 - ‘complications’
 - ‘esophageal injury’
 - ‘dysphagia’
 - ‘esophageal perforation’
 - Articles were limited to the English language and humans were defined as the subjects for all studies.

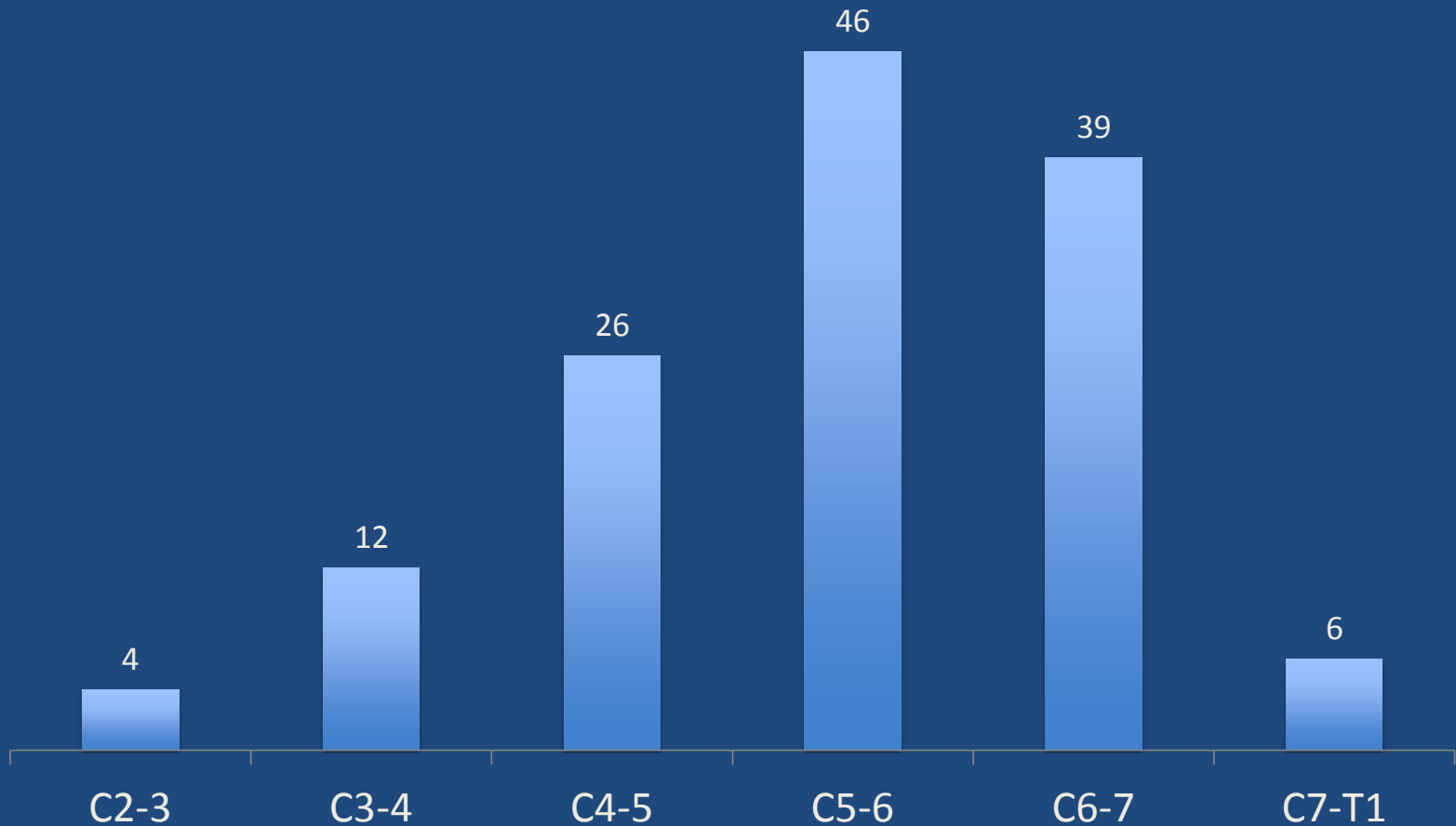
PRISMA Guidelines for Systematic Review



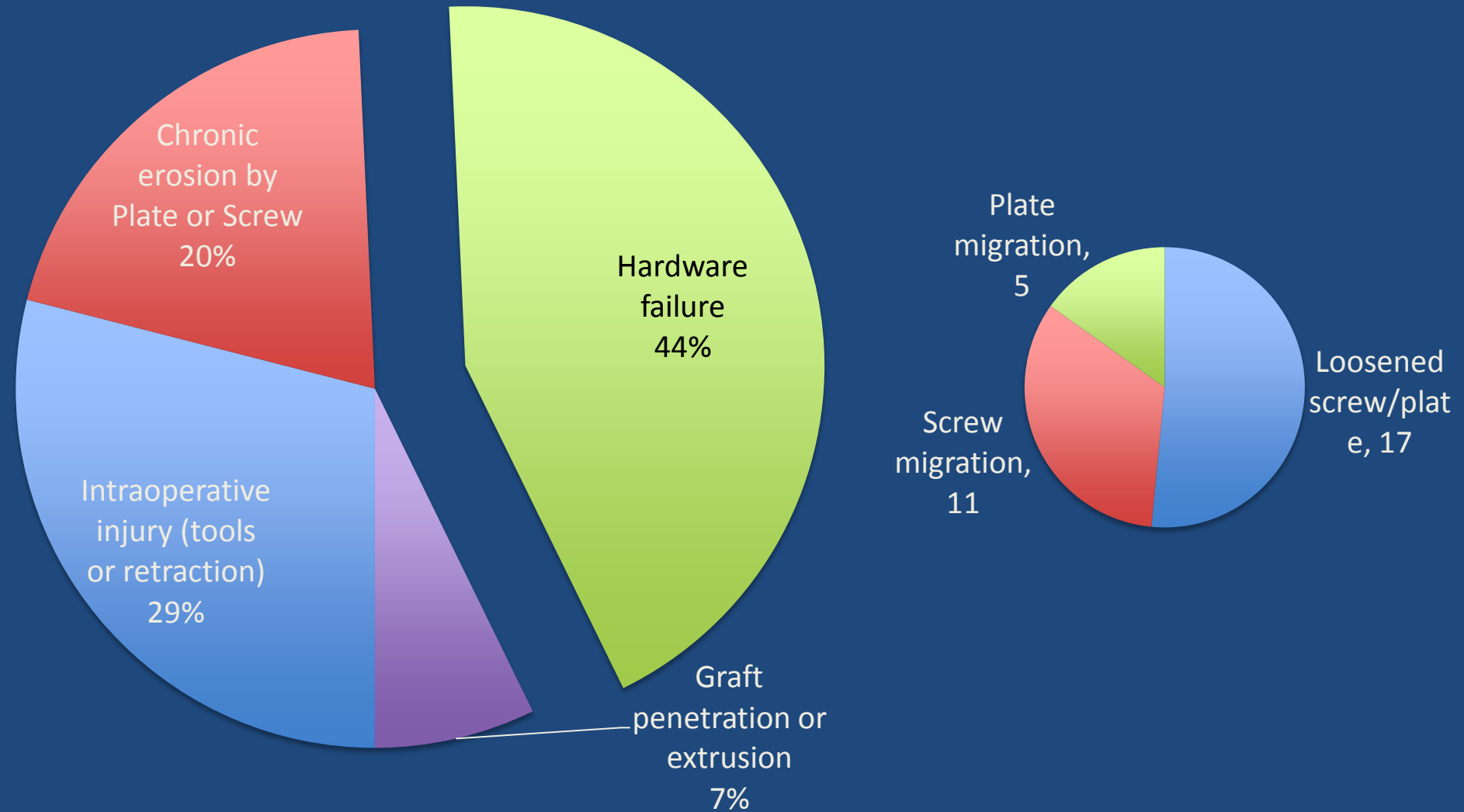
Meta-analysis: Indications for Anterior Spine Surgery



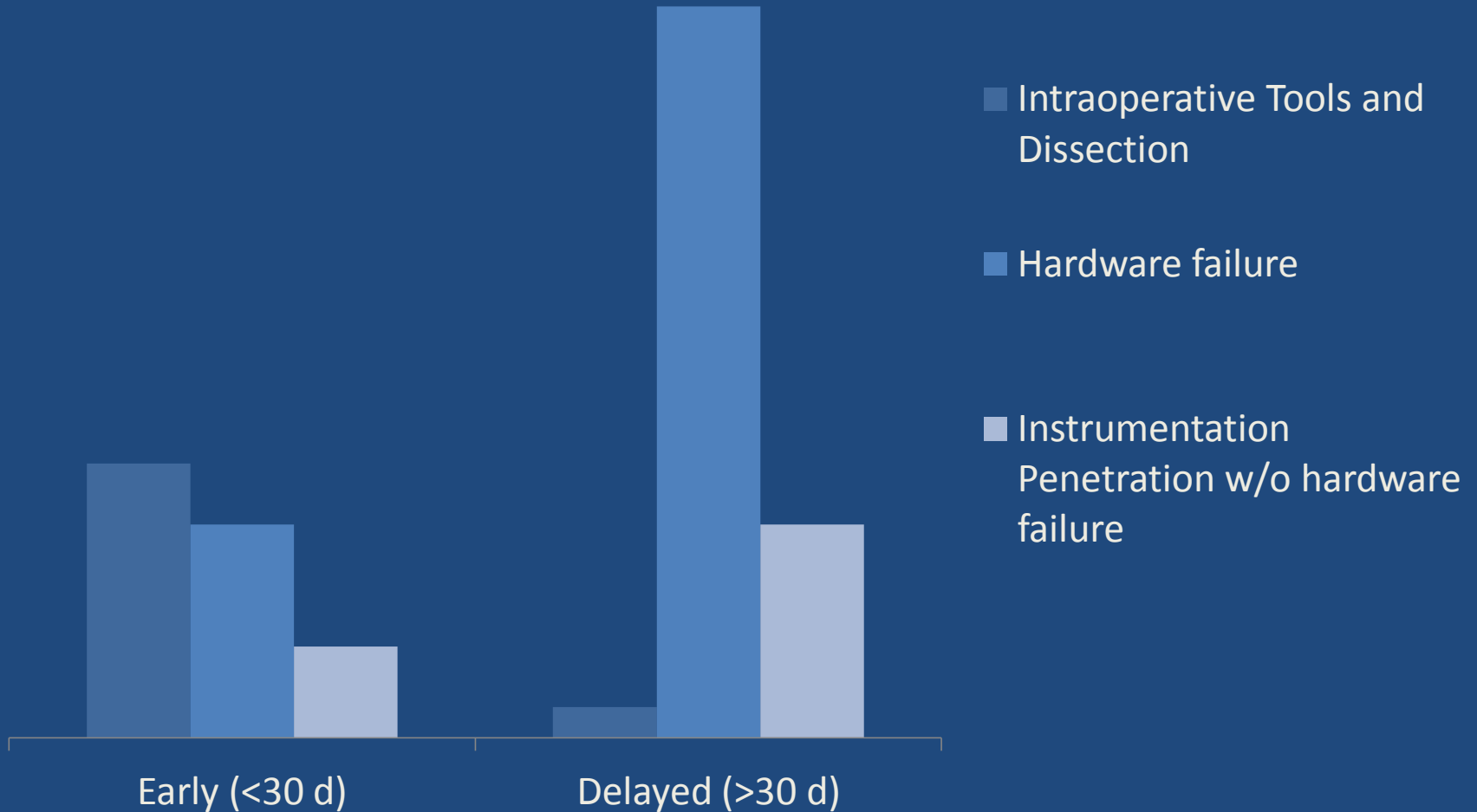
Meta-analysis: Spinal Level Operated On



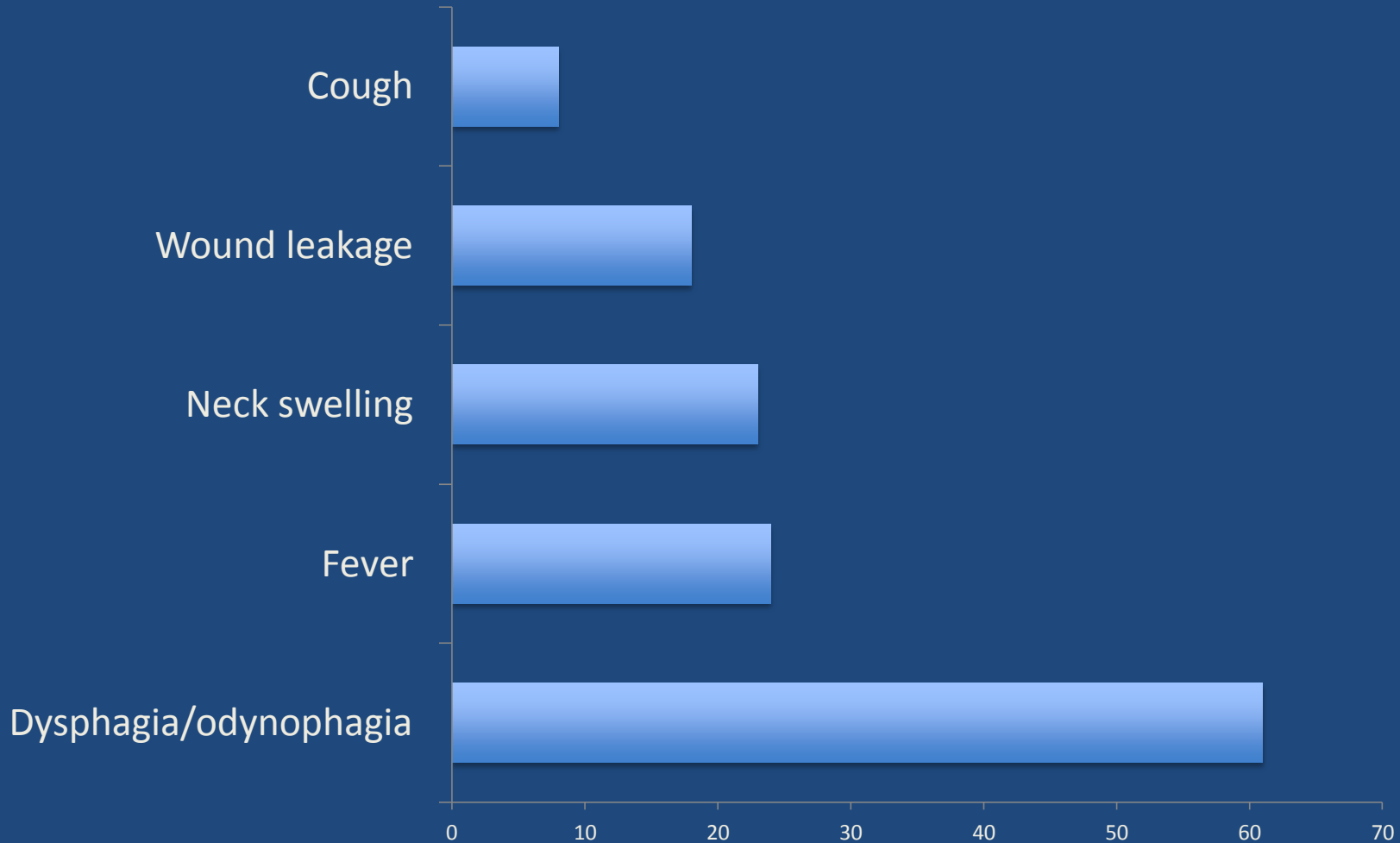
Causes of Esophageal Perforation



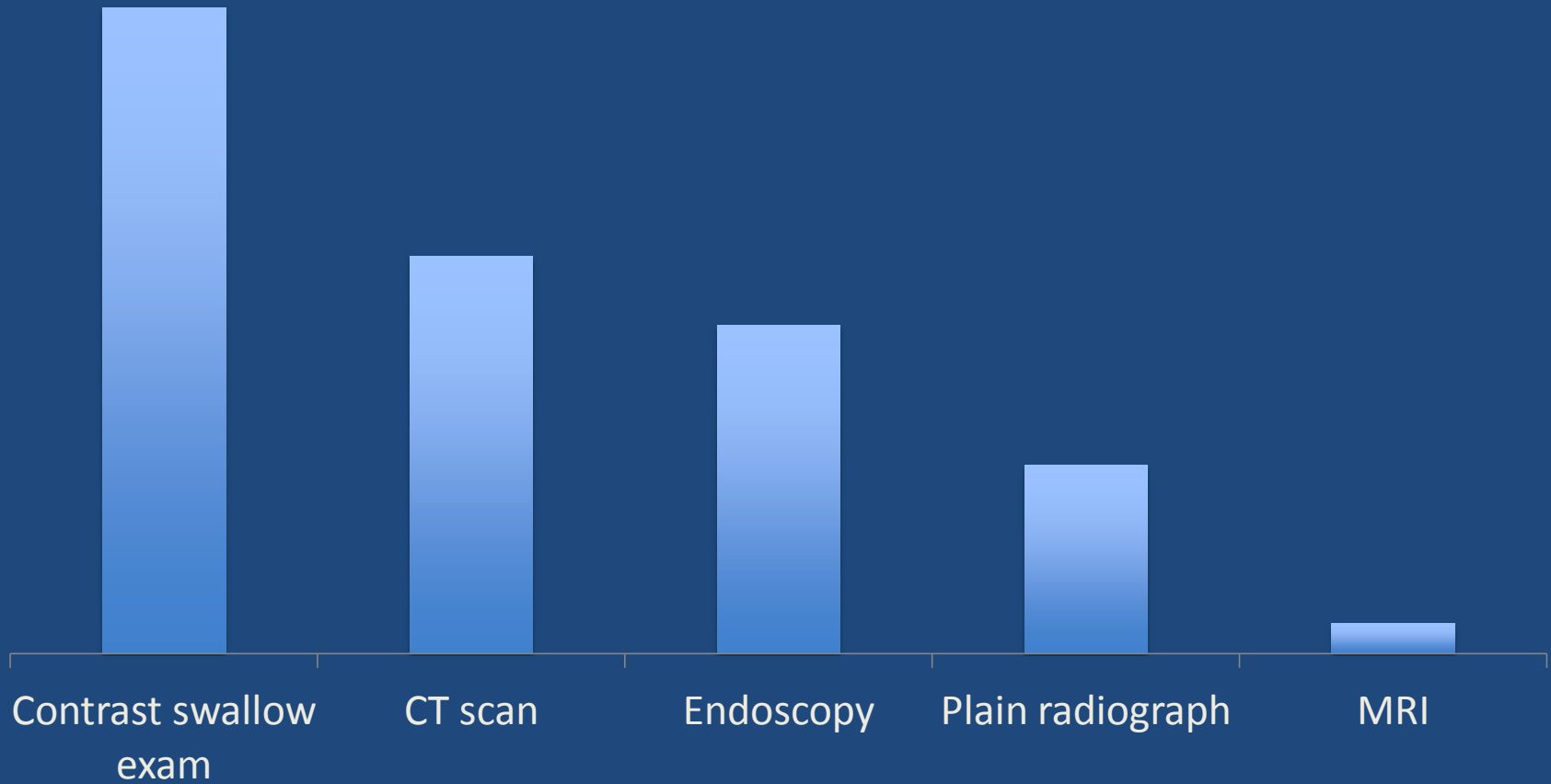
Stratification by Time to Diagnosis



Presenting Symptoms and Clinical Findings



Imaging Studies Used



Successful repair of esophageal perforation after anterior cervical fusion for cervical spine fracture

Song-Ho Ahn, Sun-Ho Lee *, Eun Sang Kim, Whan Eoh

Department of Neurosurgery Samsung Medical Center, Sungkyunkwan University, School of Medicine, 50 Ilwon-dong, Gangnam-gu, Seoul 135-710, Republic of Korea



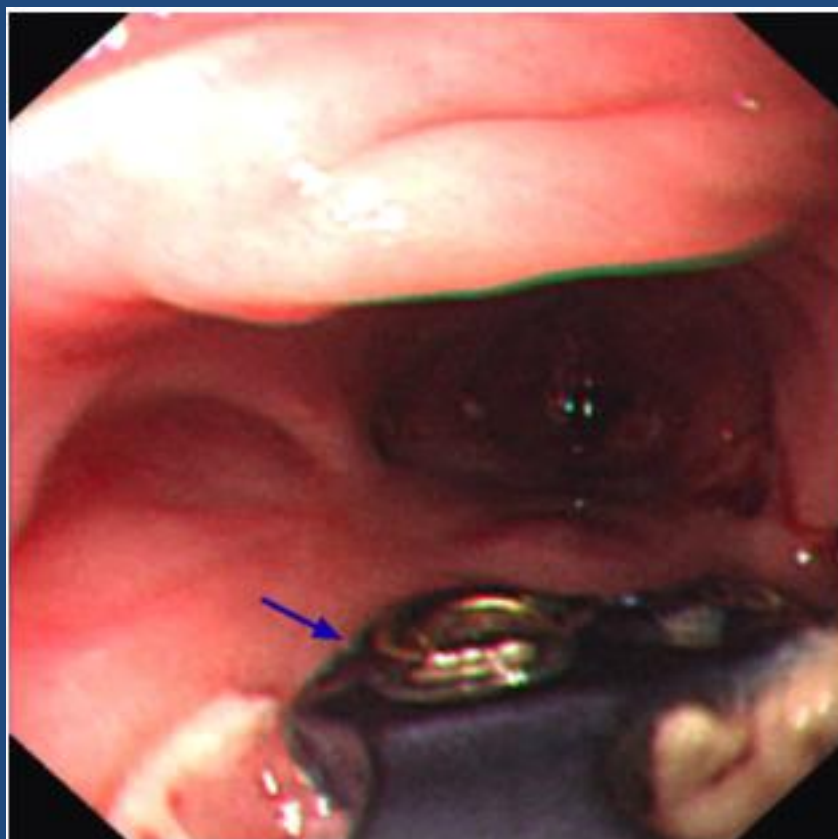
Esophageal perforation related to anterior cervical spinal surgery

Zhao-Ming Zhong^a, Jian-Ming Jiang^a, Dong-Bin Qu^a, Jian Wang^b, Xiang-Ping Li^c, Kai-Wu Lu^a, Bo Xu^a, Jian-Ting Chen^{a,*}

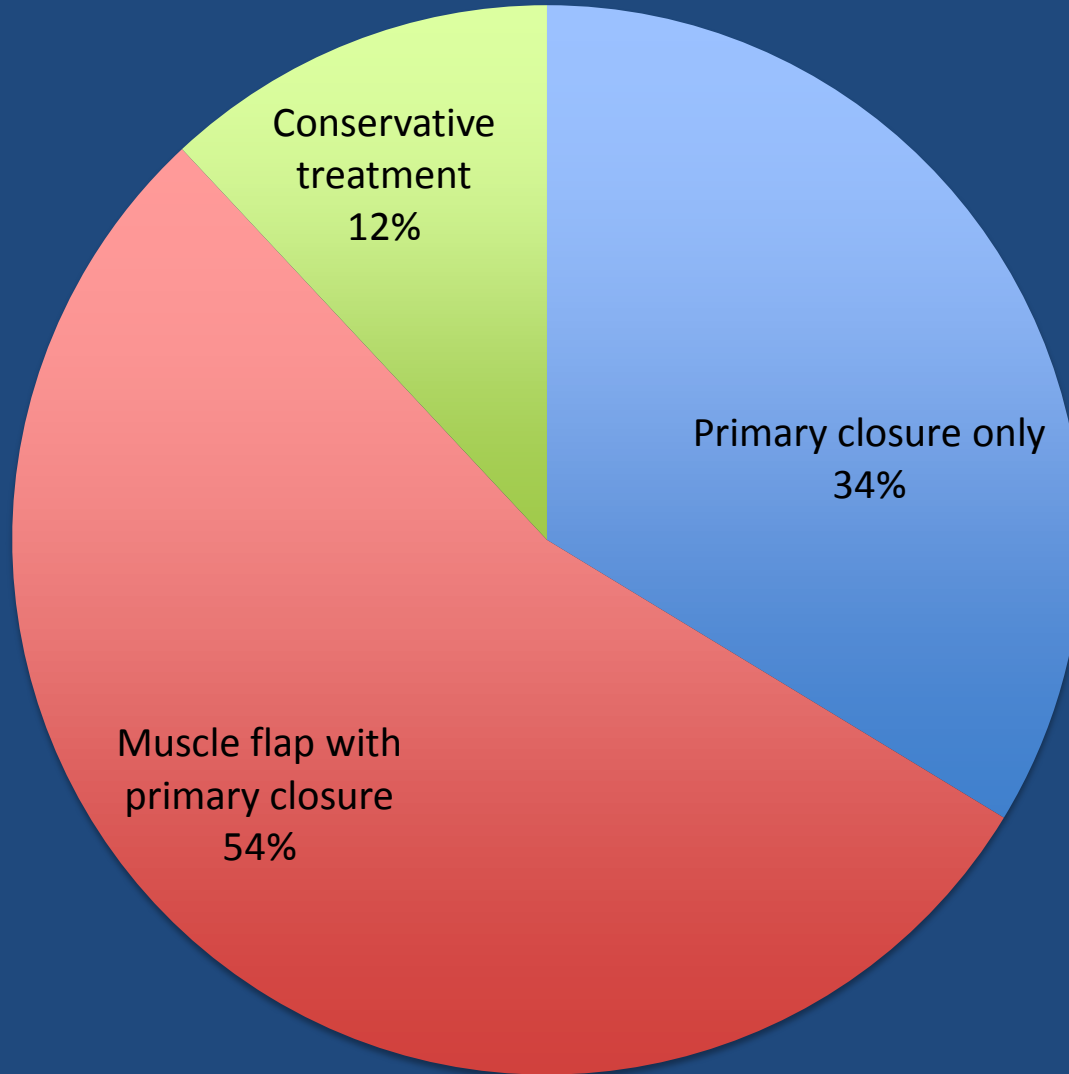
^a Department of Spinal Surgery, Nanfang Hospital, Southern Medical University, 1838 North Guangzhou Avenue, Guangzhou 510515, China

^b Department of Joint Surgery, Nanfang Hospital, Southern Medical University, Guangzhou, China

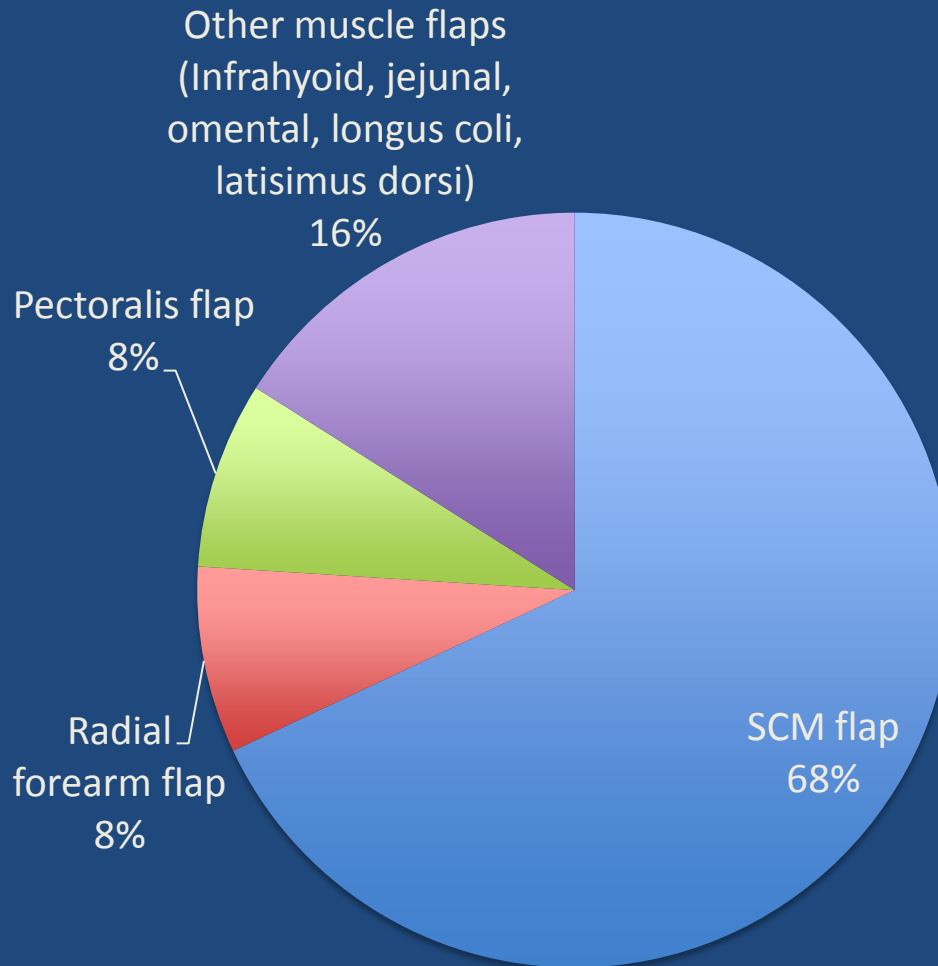
^c Department of Otolaryngology-Head and Neck Surgery, Nanfang Hospital, Southern Medical University, Guangzhou, China



Method of Esophageal Repair



Types of Muscle Flaps



Complications following Esophageal Perforation

- Secondary Complications (Incidence = 15.6%)
 - Pneumonia (n = 6)
 - Mediastinitis (n = 4)
 - Osteomyelitis (n = 3)
 - Sepsis (n = 3)
 - ARDS (n = 2)
 - Recurrent Laryngeal nerve damage (n = 1)

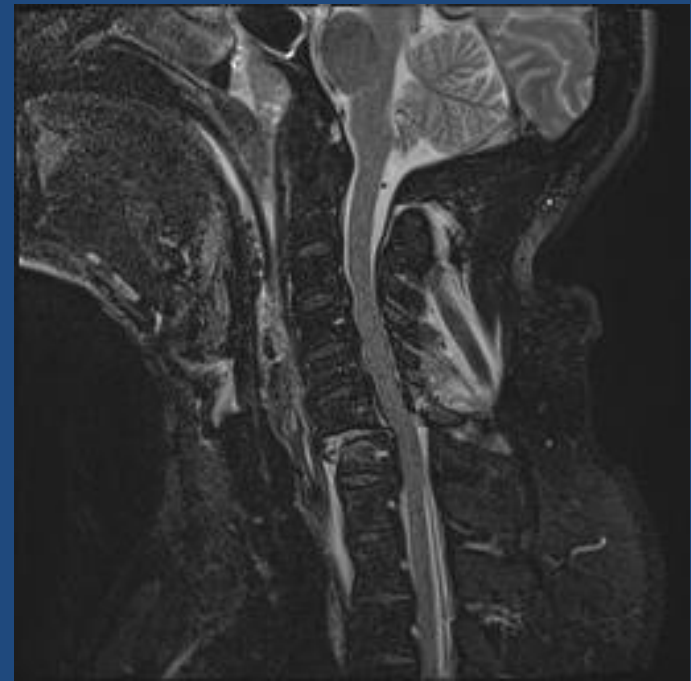
Outcomes

- Average time to oral intake = 30.43 days (range 4-188)
 - Primary repair alone: mean = 28.3 days (range 7-188)
 - SCM Flap: mean = 27.3 days (range = 6-113)
 - Conservative treatment: mean = 68 days (range = 7-135)
- Average repairs attempted= 1.57 (n = 94); range 1-9 repairs
 - 29 patients required >1 repair
 - 21 achieved complete resolution only AFTER instrumentation was removed
- Mortality incidence = 4.08% (n = 6)

Case Example

- 40-year-old Male, MVA
- C6-C7 bilateral facet perched with incomplete spinal cord injury
- CT- C6-C7 bilateral facet fracture /perch with about a 20% to 25% listhesis.
- MRI- cord compression at C6-7 due to the anterolisthesis.

Pre-operative Imaging



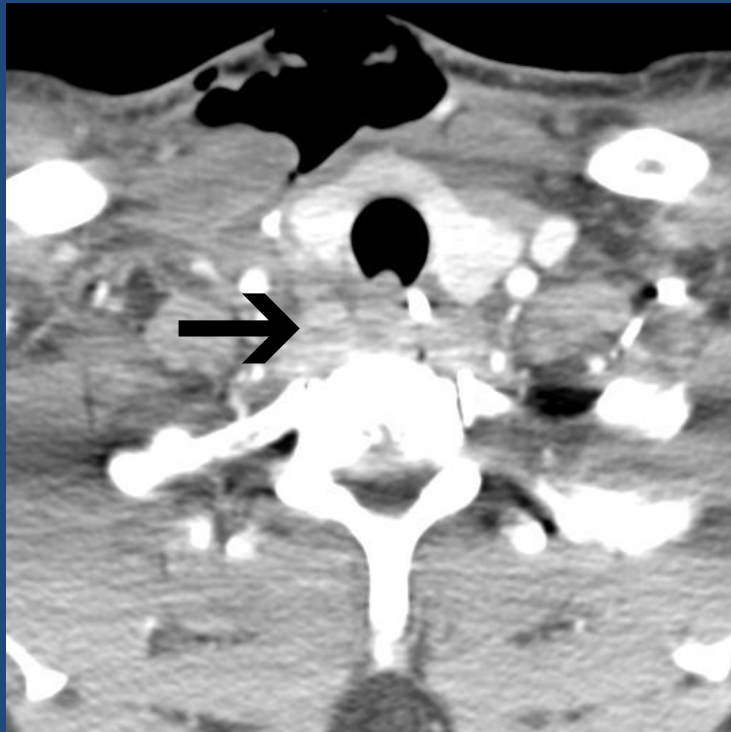
Surgery

- C6-7 ACDF with fibular strut
- No complications
- Discharged in few days



Few days later

- Subcutaneous emphysema
- Right vocal cord paralysis
- ?wound infection
- CT with oral/IV contrast



Original Article

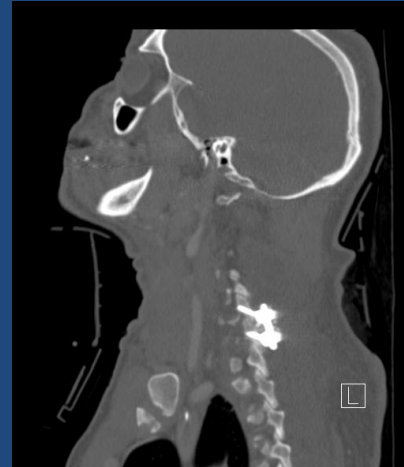
Thyroid Abscess Secondary to Perforated Carcinoma of the Oesophagus: A Rare Presentation

G Gole, R Desai, K Raghu, S Gole

Surgery for repair with ENT

- Posterior C6-7 instrumentation fusion first
- Then Rigid Esophagoscopy in OR- saw the defect
- Removal of hardware
- Esophageal defect clearly seen- Dubhoff visualized
- Esophageal repair with inf based SCM flap

Post-Operative Imaging



The Role of the Sternocleidomastoid Muscle Flap for Esophageal Fistula Repair in Anterior Cervical Spine Surgery

Ramon Navarro, MD,* Ramin Javahery, MD,* Frank Eismont, MD,† David J. Arnold, MD,†
Nitin N. Bhatia, MD,* Steve Vanni, DO,* and Allan D. Levi, MD, PhD*

- The muscle functions as a bolster for repair
- Provides a layer of separation between the esophagus and the graft/ instrumentation
- Increases the antibiotic delivery due to its vascularized nature.



Figure 2. Evidence of abscess formation in the prevertebral space in patient 5.

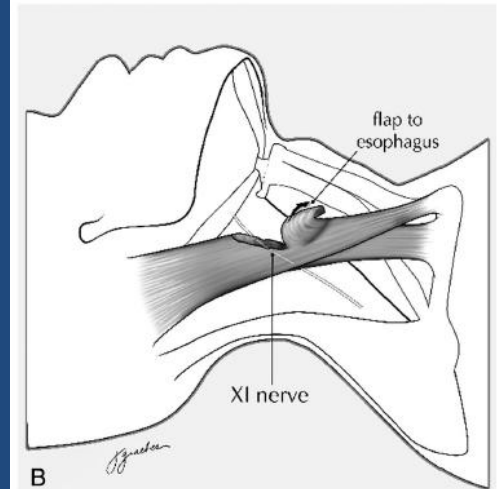
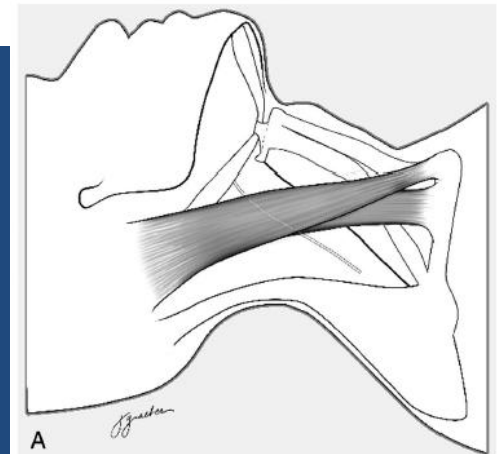


Figure 1. Surgical technique to raise the SCM flap. A, The spinal accessory nerve lies beneath the SCM and must be carefully preserved. B, Once the dissection is performed, the SCM flap is rotated toward the esophageal defect and pedicled inferiorly.

Conclusion

- Most common presenting sx = Dysphagia
- Intra-operative damage and hardware failure are the two most common causes of esophageal perforation
- Perforations are most commonly identified using contrast swallow studies
- Perforation repair is most commonly achieved using SCM flap with primary closure
- There is a high morbidity and mortality associated with esophageal perforations

References

- 1 Nanda, A., Sharma, M., Sonig, A., Ambekar, S. & Bollam, P. Surgical complications of anterior cervical discectomy and fusion for cervical degenerative disk disease: a single surgeon's experience of 1,576 patients. *World neurosurgery* **82**, 1380-1387, doi:10.1016/j.wneu.2013.09.022 (2014).
- 2 Almre, I., Asser, A. & Laisaar, T. Pharyngoesophageal diverticulum perforation 18 years after anterior cervical fixation. *Interactive cardiovascular and thoracic surgery* **18**, 240-241, doi:10.1093/icvts/ivt421 (2014).
- 3 Zhong, Z. M. *et al.* Esophageal perforation related to anterior cervical spinal surgery. *Journal of clinical neuroscience : official journal of the Neurosurgical Society of Australasia* **20**, 1402-1405, doi:10.1016/j.jocn.2012.11.020 (2013).
- 4 Wierzbicka, M., Bartochowska, A., Banaszewski, J. & Szyfter, W. Cervical oesophageal and hypopharyngeal perforations after anterior cervical spine surgery salvaged with regional and free flaps. *Neurologia i neurochirurgia polska* **47**, 43-48 (2013).
- 5 Lucas, J., Smith, E., Eskander, M., McPhee, J. & Lapinsky, A. Esophageal perforation more than 10 years after anterior cervical spine plating. *Clinical neurology and neurosurgery* **115**, 1842-1844, doi:10.1016/j.clineuro.2013.01.016 (2013).
- 6 Kroepil, F. *et al.* Treatment of early and delayed esophageal perforation. *The Indian journal of surgery* **75**, 469-472, doi:10.1007/s12262-012-0539-z (2013).
- 7 Korovessis, P., Repantis, T., Vitsas, V. & Vardakastanis, K. Cervical spondylodiscitis associated with oesophageal perforation: a rare complication after anterior cervical fusion. *European journal of orthopaedic surgery & traumatology : orthopedie traumatologie* **23 Suppl 2**, S159-163, doi:10.1007/s00590-012-1092-y (2013).
- 8 Kazi, A. A., Solowski, N. L., Postma, G. N. & Weinberger, P. M. Esophageal perforation in a patient with diverticulum following anterior discectomy and fusion. *Ear, nose, & throat journal* **92**, 506-507 (2013).
- 9 Amhaz, H. H., Kuo, R., Vaidya, R. & Orlewicz, M. S. Esophageal perforation following cervical spine surgery: A review with considerations in airway management. *International journal of critical illness and injury science* **3**, 276-278, doi:10.4103/2229-5151.124164 (2013).
- 10 Zairi, F., Tetard, M. C., Thines, L. & Assaker, R. Management of delayed oesophagus perforation and osteomyelitis after cervical spine surgery: review of the literature. *British journal of neurosurgery* **26**, 185-188, doi:10.3109/02688697.2011.609604 (2012).
- 11 Sun, L. *et al.* Causes, treatment and prevention of esophageal fistulas in anterior cervical spine surgery. *Orthopaedic surgery* **4**, 241-246, doi:10.1111/os.12006 (2012).
- 12 Lu, X., Guo, Q. & Ni, B. Esophagus perforation complicating anterior cervical spine surgery. *European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society* **21**, 172-177, doi:10.1007/s00586-011-1982-4 (2012).
- 13 Tian, H., Yuan, W., Johnson, J. S., Chen, H. & Chen, D. Pharyngoesophageal diverticulum: a delayed complication of anterior cervical spine surgery. *European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society* **20 Suppl 2**, S211-216, doi:10.1007/s00586-010-1579-3 (2011).
- 14 Ahn, S. H., Lee, S. H., Kim, E. S. & Eoh, W. Successful repair of esophageal perforation after anterior cervical fusion for cervical spine fracture. *Journal of clinical neuroscience : official journal of the Neurosurgical Society of Australasia* **18**, 1374-1380, doi:10.1016/j.jocn.2011.02.031 (2011).
- 15 Rueth, N. *et al.* Management of cervical esophageal injury after spinal surgery. *The Annals of thoracic surgery* **90**, 1128-1133, doi:10.1016/j.athoracsur.2010.06.045 (2010).
- 16 Phommachanh, V. *et al.* Otolaryngologic management of delayed pharyngoesophageal perforation following anterior cervical spine surgery. *The Laryngoscope* **120**, 930-936, doi:10.1002/lary.20747 (2010).
- 17 Kau, R. L., Kim, N., Hinni, M. L. & Patel, N. P. Repair of esophageal perforation due to anterior cervical spine instrumentation. *The Laryngoscope* **120**, 739-742, doi:10.1002/lary.20842 (2010).
- 18 Sansur, C. A., Early, S., Reibel, J. & Arlet, V. Pharyngocutaneous fistula after anterior cervical spine surgery. *European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society* **18**, 586-591, doi:10.1007/s00586-009-0951-7 (2009).
- 19 Dakwar, E., Uribe, J. S., Padhya, T. A. & Vale, F. L. Management of delayed esophageal perforations after anterior cervical spinal surgery. *Journal of neurosurgery. Spine* **11**, 320-325, doi:10.3171/2009.3.spine.08522 (2009).
- 20 Cagli, S., Isik, H. S. & Zileli, M. Cervical screw missing secondary to delayed esophageal fistula: case report. *Turkish neurosurgery* **19**, 437-440 (2009).
- 21 Ardon, H. *et al.* Oesophageal perforation after anterior cervical surgery: management in four patients. *Acta neurochirurgica* **151**, 297-302; discussion 302, doi:10.1007/s00701-009-0241-5 (2009).
- 22 Solerio, D. *et al.* Successful surgical management of a delayed pharyngo-esophageal perforation after anterior cervical spine plating. *European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society* **17 Suppl 2**, S280-284, doi:10.1007/s00586-007-0578-5 (2008).
- 23 Patel, N. P. *et al.* Esophageal injury associated with anterior cervical spine surgery. *Surgical neurology* **69**, 20-24, doi:<https://doi.org/10.1016/j.surneu.2007.05.006> (2008).
- 24 Ning, X. *et al.* Anterior cervical locking plate-related complications; prevention and treatment recommendations. *International orthopaedics* **32**, 649-655, doi:10.1007/s00264-007-0369-y (2008).
- 25 Lu, D. C., Theodore, P., Korn, W. M. & Chou, D. Esophageal erosion 9 years after anterior cervical plate implantation. *Surgical neurology* **69**, 310-312; discussion 312-313, doi:10.1016/j.surneu.2007.02.037 (2008).
- 26 Haku, T. *et al.* Repair of cervical esophageal perforation using longus colli muscle flap: a case report of a patient with cervical spinal cord injury. *The spine journal : official journal of*

- 27 Gazzeri, R., Tamorri, M., Faiola, A. & Gazzeri, G. Delayed migration of a screw into the gastrointestinal tract after anterior cervical spine plating. *Spine* **33**, E268-271, doi:10.1097/BRS.0b013e31816b8831 (2008).
- 28 Benazzo, M., Spasiano, R., Bertino, G., Occhini, A. & Gatti, P. Sternocleidomastoid muscle flap in esophageal perforation repair after cervical spine surgery: concepts, techniques, and personal experience. *Journal of spinal disorders & techniques* **21**, 597-605, doi:10.1097/BSD.0b013e31815c5f96 (2008).
- 29 Sahjpaul, R. L. Esophageal perforation from anterior cervical screw migration. *Surgical neurology* **68**, 205-209, doi: <http://dx.doi.org/10.1016/j.surneu.2006.09.032> (2007).
- 30 Nourbakhsh, A. & Garges, K. J. Esophageal perforation with a locking screw: a case report and review of the literature. *Spine* **32**, E428-435, doi:10.1097/BRS.0b013e318074d56c (2007).
- 31 Fountas, K. N. *et al.* Anterior cervical discectomy and fusion associated complications. *Spine* **32**, 2310-2317, doi:10.1097/BRS.0b013e318154c57e (2007).
- 32 Pichler, W., Maier, A., Rapp, T., Clement, H. G. & Grechenig, W. Delayed hypopharyngeal and esophageal perforation after anterior spinal fusion: primary repair reinforced by pedicled pectoralis major flap. *Spine* **31**, E268-270, doi:10.1097/01.brs.0000215012.84443.c2 (2006).
- 33 Fountas, K. N., Kapsalaki, E. Z., Machinis, T. & Robinson, J. S. Extrusion of a screw into the gastrointestinal tract after anterior cervical spine plating. *Journal of spinal disorders & techniques* **19**, 199-203, doi:10.1097/01.bsd.0000164164.11277.49 (2006).
- 34 von Rahden, B. H., Stein, H. J. & Scherer, M. A. Late hypopharyngo-esophageal perforation after cervical spine surgery: proposal of a therapeutic strategy. *European spine journal: official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society* **14**, 880-886, doi:10.1007/s00586-005-1006-3 (2005).
- 35 Navarro, R. *et al.* The role of the sternocleidomastoid muscle flap for esophageal fistula repair in anterior cervical spine surgery. *Spine* **30**, E617-622 (2005).
- 36 Lee, S. H. *et al.* Esophageal perforation by cervical fixation device. *Gastrointestinal endoscopy* **61**, 295 (2005).
- 37 Konstantakos, A. K. & Temes, R. T. Delayed Esophageal Perforation: A Complication of Anterior Cervical Spine Fixation. *The Annals of thoracic surgery* **80**, 349, doi: <http://dx.doi.org/10.1016/j.athoracsurg.2005.09.011> (2005).
- 38 De Moor, V. *et al.* Oesophageal perforation by an anterior cervical fixation device: management in debilitated patients. *Acta gastro-enterologica Belgica* **68**, 267-269 (2005).
- 39 Zdicavsky, M. *et al.* Late esophageal perforation complicating anterior cervical plate fixation in ankylosing spondylitis: a case report and review of the literature. *Archives of orthopaedic and trauma surgery* **124**, 349-353, doi:10.1007/s00402-004-0654-9 (2004).
- 40 Vrouwenraets, B. C., Been, H. D., Brouwer-Mladin, R., Bruno, M. & van Lanschot, J. J. Esophageal perforation associated with cervical spine surgery: report of two cases and review of the literature. *Digestive surgery* **21**, 246-249, doi:10.1159/000079495 (2004).
- 41 Reid, R. R., Dutra, J., Conley, D. B., Ondra, S. L. & Dumanian, G. A. Improved repair of cervical esophageal fistula complicating anterior spinal fusion: free omental flap compared with pectoralis major flap. Report of four cases. *Journal of neurosurgery* **100**, 66-70 (2004).
- 42 Witwer, B. P. & Resnick, D. K. Delayed esophageal injury without instrumentation failure: complication of anterior cervical instrumentation. *Journal of spinal disorders & techniques* **16**, 519-523 (2003).
- 43 Shenoy, S. N. & Raja, A. Delayed pharyngo-esophageal perforation: rare complication of anterior cervical spine surgery. *Neurology India* **51**, 534-536 (2003).
- 44 Orlando, E. R., Caroli, E. & Ferrante, L. Management of the cervical esophagus and hypopharynx perforations complicating anterior cervical spine surgery. *Spine* **28**, E290-295, doi:10.1097/01.brs.0000087093.89889.0a (2003).
- 45 Kuntscher, M. V., Erdmann, D., Boltze, W. H. & Germann, G. Use of a free jejunal graft for oesophageal reconstruction following perforation after cervical spine surgery: case report and review of the literature. *Spinal cord* **41**, 543-548, doi:10.1038/sj.sc.3101439 (2003).
- 46 Okawa, A., Yoshida, H., Haro, H. & Shinomiya, K. Esophageal invagination to a graft after cervical corpectomy. Case illustration. *Journal of neurosurgery* **96**, 136 (2002).
- 47 Kim, Y. J. & Glazer, P. A. Delayed esophageal perforation and abscess formation after cervical vertebrectomy and fusion. *Orthopedics* **25**, 1091-1093 (2002).
- 48 Finiels, P. J., Hernandez, G., Sabatier, P. & Frerebeau, P. Delayed esophageal perforation after cervical osteosynthesis. Case illustration. *Journal of neurosurgery* **92**, 123 (2000).
- 49 Eleraky, M. A., Llanos, C. & Sonntag, V. K. Cervical corpectomy: report of 185 cases and review of the literature. *Journal of neurosurgery* **90**, 35-41 (1999).
- 50 Hanci, M. *et al.* Esophageal perforation subsequent to anterior cervical spine screw/plate fixation. *Paraplegia* **33**, 606-609, doi:10.1038/sc.1995.128 (1995).
- 51 Smith, M. D. & Bolesta, M. J. Esophageal perforation after anterior cervical plate fixation: a report of two cases. *Journal of spinal disorders* **5**, 357-362 (1992).
- 52 van Berge Henegouwen, D. P., Roukema, J. A., de Nie, J. C. & vd Werken, C. Esophageal perforation during surgery on the cervical spine. *Neurosurgery* **29**, 766-768 (1991).
- 53 Thomas, J. P. & Finch, R. Esophageal erosion. A complication of acrylic fixation in anterior cervical fusion. *Spine* **16**, 1238-1240 (1991).
- 54 Kelly, M. F., Spiegel, J., Rizzo, K. A. & Zwillenberg, D. Delayed pharyngo-esophageal perforation: a complication of anterior spine surgery. *The Annals of otology, rhinology, and laryngology* **100**, 201-205 (1991).
- 55 Fuji, T. *et al.* Esophagocutaneous fistula after anterior cervical spine surgery and successful treatment using a sternocleidomastoid muscle flap. A case report. *Clinical orthopaedics and related research*, 8-13 (1991).
- 56 Newhouse, K. E., Lindsey, R. W., Clark, C. R., Lieponis, J. & Murphy, M. J. Esophageal perforation following anterior cervical spine surgery. *Spine* **14**, 1051-1053 (1989).
- 57 Kuriloff, D. B., Blaugrund, S., Ryan, J. & O'Leary, P. Delayed neck infection following anterior spine surgery. *The Laryngoscope* **97**, 1094-1098 (1987).
- 58 Rubin, J. S. Sternocleidomastoid myoplasty for the repair of chronic cervical esophageal fistulae. *The Laryngoscope* **96**, 834-836 (1986).
- 59 Whitehill, R., Sirna, E. C., Young, D. C. & Cantrell, R. W. Late esophageal perforation from an autogenous bone graft. Report of a case. *The Journal of bone and joint surgery. American volume* **67**, 644-645 (1985).
- 60 Balmaseda, M. T., Jr. & Pellioni, D. J. Esophagocutaneous fistula in spinal cord injury: a complication of anterior cervical fusion. *Archives of physical medicine and rehabilitation* **66**, 783-784 (1985).
-