Published by Elsevier Inc.
0003-4975/$36.00 e207
https://doi.org/10.1016/j.athoracsur.2021.05.019

Combined Excision of Costal Cartilage and Rib Plating for Slipped Rib Syndrome

Hollie C. Rudolph, MPAS, PA-C, and Brian T. Nam, MD

Department of Thoracic Surgery and Interventional Pulmonology, ChristianaCare, Newark, Delaware

Slipped rib syndrome is often underdiagnosed and can be a source of significant discomfort and frustration for patients. Multiple conservative treatment approaches and surgical procedures have been described in the literature without a definitive standard. This report presents a case report using 2 surgical techniques, including excision of the affected costal cartilage in conjunction with placement of bioabsorbable rib plates. This technique could reduce the risk of recurrence as well as restore normal chest wall structure and function.

(Ann Thorac Surg 2022;113:e207-e209)

Slipped rib syndrome is an anatomic defect involving the cartilage of the lower rib cage. Whether congenital or secondary to trauma,[1] the syndrome is caused by hypermobility and subluxation of the anterior costal cartilage commonly of rib 8, 9, or 10, singly or in combination.[2-4] Slipped rib syndrome is often underdiagnosed, or the diagnosis is delayed,[1,2] and this can lead to significant pain related to impingement of the intercostal nerves by the luxating cartilage tips.

Patients can present with lower chest wall discomfort, hypermobility of the lower ribs, or even an audible clicking sound with certain movements.[2] History and physical examination are typically adequate for diagnosis. Hypermobility may be palpable with or without use of the hooking manuever.[2,5] Imaging may be useful to exclude other causes of symptoms, such as rib fracture, muscle tear, costochondritis, bone metastasis, Tietze syndrome, and abdominal disease.[1,2,4] Dynamic ultrasound imaging has been used to confirm the diagnosis.[6]

Various treatment approaches for slipped rib syndrome have been described in the literature. Conservative approaches include analgesic pain medications (eg, paracetamol, nonsteroidal anti-inflammatory drugs, gabapentin)[2,4] and intercostal nerve block.[1,2] Surgical approaches have included rib resection,[2] cartilage resection,[4,7] vertical rib plating,[3] and rib fixation.[1] No definitive standard exists. Costal cartilage of the ribcage has both structural and mechanical functions. It serves as a flexible interface between the sternum and ribs while allowing for expansion of the thorax during respiration. It can also act as a shock absorber during trauma to the ribcage.[8] We offer a surgical option that attempts to recreate the normal chest wall structure and preserve chest wall mechanics.

A middle-aged, physically active man self-referred to our thoracic surgery clinic (at ChristianaCare, Newark, DE) for chronic right rib pain that had been present since his teens. The patient researched his symptoms online, came across the diagnosis of slipped rib syndrome, and presented for evaluation. He described a rubbing sensation of the ribs in his lower chest wall. On examination, hypermobility and subluxation of the 10th rib were noted, and an audible click could be reproduced with maneuvers. A dynamic ultrasound scan was performed, and it confirmed the diagnosis.

General anesthesia using a single-lumen endotracheal tube was established, and the patient was placed in the supine position with the left arm tucked and right arm abducted at a 90-degree angle. A 5-cm transverse incision was centered over the anterior ninth intercostal space. The skin and subcutaneous fascia were divided, followed by separation of the external oblique muscle to expose the costal margin. A defect of both the ninth and 10th anterior costal cartilages was identified (Figure 1). The medial aspects of the interrupted cartilaginous tips were resected. Three bioabsorbable rib plates (BioBridge, Acute Innovations, Hillsboro, OR) were placed horizontally on the surfaces of ribs 8, 9, and 10. Multiple 0-0 polyethylene terephthalate (Ethibond, Ethicon, Somerville, NJ) sutures were carefully placed through the superior aspect of each rib to avoid the intercostal neurovascular bundle. One additional plate was then placed in a vertical, or perpendicular, fashion and secured to the medial aspects of each rib plate (Figure 2). The external oblique muscle was closed, followed by subcutaneous tissue and skin closure. A chest radiograph was performed in recovery to confirm the absence of pneumothorax. The patient was discharged on the same day of surgery with a multimodal pain regimen consisting of acetaminophen, ketorolac, gabapentin, and oxycodone. By day 6, the patient had discontinued all medications. At 1 month, the patient reported significant improvement in his functional ability, with nearly resolved chest discomfort and relief from the slipping sensation. On examination, hypermobility of the ribs

Accepted for publication May 8, 2021.
Address correspondence to Ms Rudolph, Department of Thoracic Surgery and Interventional Pulmonology, ChristianaCare, 4701 Ogletown-Stanton Rd, Ste 2100, Newark, DE 19713; email: hollie.c.rudolph@christianacare.org.

Ann Thorac Surg
2022;113:e207-e209

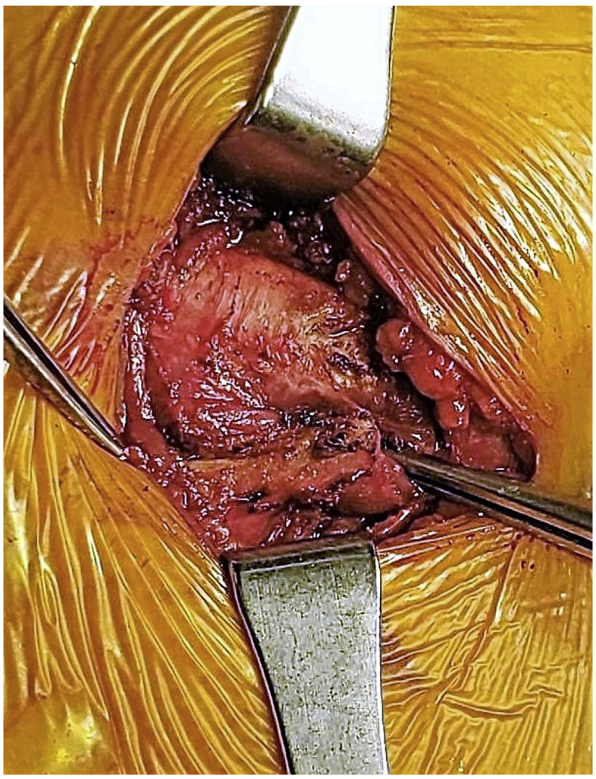

FIGURE 1 Damaged cartilage tip.

was no longer palpable, and an audible click could not be reproduced.

COMMENT

Slipped rib syndrome is often underdiagnosed and can be a source of significant discomfort for patients. Multiple surgical techniques have been described previously, including simple excision of the costal cartilage, excision of ribs and cartilage, binding of the affected ribs, and vertical rib plating.[1-4,7] Our technique incorporated excision of damaged cartilage and placement of bioabsorbable rib plates. Excision of the costal cartilage tips was performed to reduce the risk of recurrent friction or subluxation.[7] A scaffold of horizontal and vertical rib plates was placed to reproduce the cartilaginous structure of this section of the chest wall. As the plates absorb over 18 months through hydrolysis, a flexible structure will be left behind that could help recreate the normal anatomy and physiology of this section of the thorax. We offer this as an option for the treatment of slipped rib syndrome.

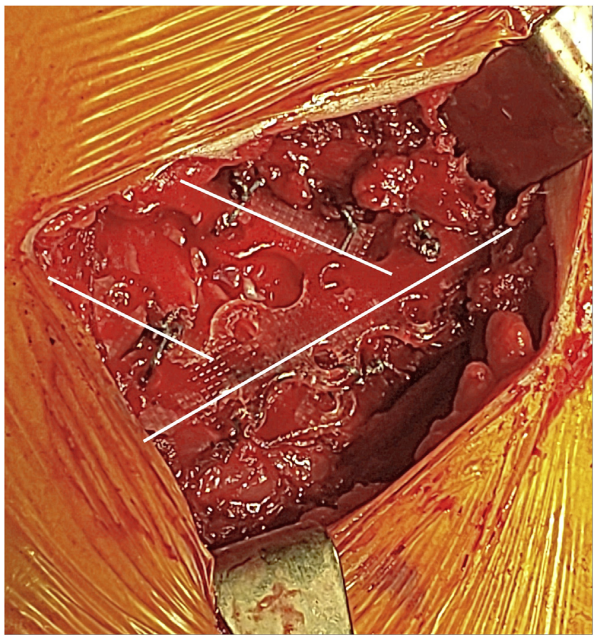

FIGURE 2 Bioabsorbable rib plates placed horizontally and vertically to create stable scaffold.

REFERENCES

1. Hansen A, Toker A, Hayanga J, Buenaventura P, Spear C, Abbas G. Minimally invasive repair of adult slipped rib syndrome without costal cartilage excision. *Ann Thorac Surg*. 2020;110:1030-1035.

2. Van Delft EA, van Pul KM, Bloemers FW. The slipping rib syndrome: a case report. *Int J Surg Case Rep*. 2016;23:23-24.

3. McMahon LE, Salevitz NA, Notrica DM. Vertical rib plating for the treatment of slipping rib syndrome. *J Pediatr Surg*. 2021;56:1852-1856.

4. Penn Medicine. Surgical management of slipping rib syndrome. Available at: https://www.pennmedicine.org/for-health-care-professionals/for-physicians/physician-education-and-resources/clinical-briefings/2019/october/surgical-management-of-slipping-rib-syndrome. Accessed December 24, 2020.

5. Heinz GJ III, Zavala DC. Slipping rib syndrome: diagnosis using the "hooking maneuver. *JAMA*. 1977;237:794-795.

6. Meuwly JY, Wicky S, Schnyder P, Lepori D. Slipping rib syndrome: a place for sonography in the diagnosis of a frequently overlooked cause of abdominal or low thoracic pain. *J Ultrasound Med*. 2002;21:339-343.

7. Fraser JA, Briggs KB, Svetanoff WJ, St. Peter SD. Long-term outcomes and satisfaction rates after costal cartilage resection for slipping rib syndrome. *J Pediatr Surg*. 2021;56:2258-2262.

8. Lau A, Oyen ML, Kent RW, Murakami D, Torigaki T. Indentation stiffness of aging human costal cartilage. *Acta Biomater*. 2008;4,1:97-103.