



## Slipping rib syndrome in childhood. A case series

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### ABSTRACT

Among the causes of chest pain, slipping rib has a low prevalence, usually with a history of trauma, and its management is controversial. Slipping rib syndrome should be included in the differential diagnosis of causes of chest pain in children. When not associated with previous trauma and cartilage deformity, it is necessary to consider an alteration in rib development, regardless of the typical traumatic etiology in adults. Here we describe a series of pediatric patients with slipping rib seen at a referral hospital between 2001 and 2022. Nine patients aged 11 to 16 years were included. Only 2 had a history of trauma. All patients described a sudden onset of severe thoracic abdominal pain. The patients underwent open resection of the affected costal cartilages, with resolution of pain.

**Keywords:** chest pain; child; slipping rib syndrome; pediatrics; surgery.

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## INTRODUCTION

Slipping rib syndrome is a cause of debilitating thoracic abdominal pain at the level of the costal margin. It must be differentiated from conditions with similar clinical characteristics (costochondritis, rib fractures, neoplasms, or cardiac or gastrointestinal anomalies).<sup>1</sup> Reports of slipping rib syndrome in young patients are scarce; the youngest case was reported in a 7-year-old patient.<sup>2</sup> The existing bibliography on this syndrome highlights trauma at the rib level as a consistent element in etiology; descriptions associated with athletes are very common.<sup>3</sup>

In this article, we describe a series of pediatric patients with slipping rib seen at a referral hospital between 2001 and 2022. In addition, we highlight the differences with adult cases and propose some hypotheses that may justify them.

## POPULATION AND METHODS

Study of cases recorded at the Unit of Pediatric Thoracic Anomalies of Hospital Universitario Central de Asturias (Spain). Once the Ethics Committee approved the study (CEImPA reference: 2022.040) and the implicit consent was obtained from all the patients' legal tutors, the electronic medical records of children diagnosed

with slipping rib syndrome and seen between 2001 and 2022 were reviewed. The instructions established in the Data Protection Law (Law no. 41/2002) for the analysis of clinical-health care data were followed.

The medical records were assessed to collect demographic variables (sex, age at symptom onset, age at diagnosis, referring healthcare provider, age at surgery) and clinical variables (events that triggered pain, location, intensity, duration, diagnostic methods, previous treatments, type of surgery, surgical findings, and course).

The data were recorded in an Access® table and descriptive statistics were applied depending on the nature of the variable by means of dispersion variables and standard deviation.

## CASE SERIES

Ten pediatric cases were identified. One case was ruled out due to insufficient documentation. Therefore, a total of 9 patients who underwent 10 procedures were analyzed (*Table 1*). Children were aged 11 to 16 years. Of the 9 patients, 6 were girls. A history of trauma was detected in only 2 patients: a 13-year-old male who reported chest trauma following a go kart accident and a

**TABLE 1. Patients' characteristics**

Case	Age (years)	Sex	Duration of clinical condition	Traumatic event	Imaging tests	Affected ribs	Course (follow-up)
1	14	F	18 months	No	X-ray+ULT	R. 10 <sup>th</sup>	Asymptomatic (146 months)
2	16	F	5 months	Blow against a door	X-ray	R. 8 <sup>th</sup>	Asymptomatic (131 months)
3	13	M	9 months	No	X-ray+ULT	R. 9 <sup>th</sup>	Asymptomatic (125 months)
4	14	F	2 months	No	ULT+CT	L. 8 <sup>th</sup> , 9 <sup>th</sup> , and 10 <sup>th</sup>	Asymptomatic (104 months)
5	11	F	7 months	No	ULT+CT	L. 8 <sup>th</sup> and 9 <sup>th</sup>	Asymptomatic (98 months)
6	15	M	4 months	No	ULT	L. 10 <sup>th</sup>	Asymptomatic (91 months)
7	12	F	5 months	No	X-ray+ULT+CT	R. 9 <sup>th</sup>	Asymptomatic (79 months)
8	13	M	5 months	Traffic accident	X-ray+ULT+CT	R. 8 <sup>th</sup> and 9 <sup>th</sup>	Asymptomatic (25 months)
9	14	F	16 months	No	ULT+CT	R. 9 <sup>th</sup> L. 9 <sup>th</sup> and 10 <sup>th</sup>	Contralateral asynchronous pain Pending new surgery

F: female, M: male, X-ray: chest X-ray, ULT: chest ultrasound, CT: computed tomography scan, R.: right, L.: left.

16-year-old female adolescent who recalled a not very intense blow against a door on the costal margin. In the remaining 7 cases, there was no history of trauma or intense physical activity that would justify the onset of symptoms.

The process of referral to surgery in almost all cases was complex. As shown in *Table 1*, the time elapsed between the onset of symptoms and diagnosis was very long, with a median of 5 months. For the referral of these patients to our practice, numerous healthcare providers had to become involved, from pediatricians to psychiatrists, rehabilitation physicians, general practitioners, and orthopedic surgeons.

Although only 2 of the 9 cases had a history of trauma, all patients were able to recall a specific moment of sudden onset of pain, which they could localize by pointing a finger to an area of the chest. Pain resulted in the use of high doses of painkillers and anti-inflammatory drugs (mostly AINEs) and, exceptionally, opioids. It also affected life habits with mood changes and depressive symptoms, even reaching psychiatric consultations with suicide attempts. Discomfort remained constant, with peaks of variable duration that resulted in disability. All the patients in our series described the onset of nausea accompanying the pain.

Two of the early series patients (patients 2 and 3) underwent local infiltration of local anesthesia and corticosteroids (bupivacaine and dexamethasone), with little response. In the last 2 patients, the Pain Unit of our hospital performed a block of the lateral branches of the intercostal nerves in the middle axillary line (BRILMA block) with ropivacaine and betamethasone, and ultrasound follow-up, with immediate response, but without results beyond the short term. The last patient (the bilateral case) is pending the association of intercostal nerve radiofrequency after serial blocks. Except for the referred patients in whom an intercostal block was attempted, all the patients underwent surgery as the first non-pharmacological treatment.

Patients were given general anesthesia and local and regional block to perform an open anterior approach and remove the affected cartilages which, strikingly, had an anomalous hooked configuration overlapping under the adjacent cartilage (*Figure 2*) and a “clicking” effect with gentle pressure on it due to friction with the adjacent cartilage.

The location of the affected cartilages was restricted to the false ribs (mostly the 9<sup>th</sup> rib

(*Figure 1*). The number of cartilages involved varied from 1 to 3, and a discrete predominance on the right side was observed (5 of 9). The pathological examination of all resected pieces reported that they corresponded to cartilage tissue without histological alterations.

It is worth noting intraoperative findings: the affected costal cartilages had a strikingly curved shape at the proximal end, with marked superior concavity, and clear compression of the costal neurovascular bundle (*Figure 2*).

The 10 surgeries in the 9 patients were uneventful, with an average surgery duration of 150 minutes. Patients were discharged the day after surgery, with adequate analgesic control in the immediate postoperative period. In the control appointment one month after surgery, complete resolution of pain was observed in all patients, with minimal discomfort secondary to the procedure and complete satisfaction. The postoperative follow-up period ranged from 5 months to 20 years. No recurrence was noted.

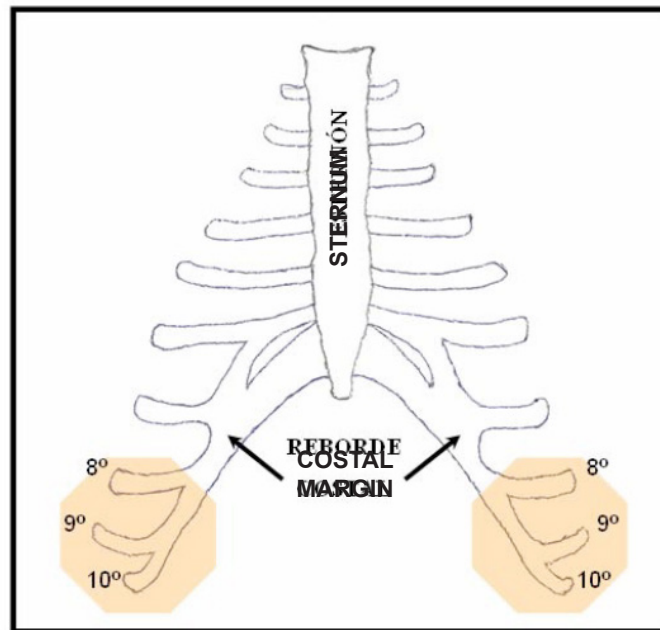
## DISCUSSION

The slipping rib syndrome is an underdiagnosed cause of chronic thoracic abdominal pain.<sup>4–6</sup> It was originally described as a syndrome affecting the floating ribs (one of the names used was “twelfth rib syndrome”) and was typically unilateral.<sup>7</sup> However, several current series have found that the etiology is based on the involvement of the false ribs (8<sup>th</sup>, 9<sup>th</sup>, and 10<sup>th</sup>), with possible bilateral occurrence.<sup>2,8</sup>

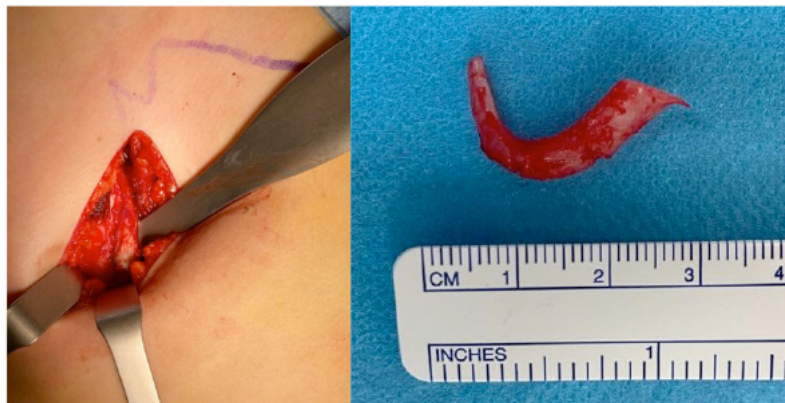
There are few references in pediatric patients.<sup>2,9</sup> After the first description made by Cyriax in 1919, successive descriptions highlight the low incidence, the involvement of young adults, and its relationship with sports and trauma.<sup>10,11</sup> Most authors who have referred to slipping rib syndrome emphasize the diagnostic delay, sometimes months and years, that accompanies these cases.<sup>12</sup>

In our series, the X-ray of the rib cage did not provide any information and, except in one case, the ultrasound did not show any alteration either. A dynamic ultrasound (mobilizing the ribs) was performed in the last 2 patients, but it did not provide any additional information. A computed tomography scan completed the diagnosis in 55% of the subjects and, although it was not diagnostic of this syndrome, it was useful to rule out other conditions (fractures, rib tumors, chondritis, etc.).

Therefore, the history and clinical examination

**FIGURE 1. Areas of pain location**

*The affected area is consistent with the false ribs (highlighted).*

**FIGURE 2. Resection of costal cartilage**

*Subperichondrial resection of the right eighth costal cartilage (left) and resected cartilage showing striking concavity (right).*

of these pediatric patients was the basis of their diagnosis. The hooking maneuver (which involves placing the fingers of the examiner beneath the affected costal margin with an upward lift), performed gently, caused a striking increase in discomfort after a “clicking” sensation during the maneuver.

Nociceptive afferent stimuli transmitted through intercostal nerves converge at the spinal level with the splanchnic nerves. Therefore, the origin of the pain may be confused and located at

the abdominal level, so the differential diagnosis should exclude a condition at this level.

The different treatments are classified into analgesic/anesthetic techniques that seek to minimize pain through nerve blocks, or surgical techniques targeted at avoiding the mechanical effect of cartilage compression.<sup>12,13</sup> No cartilage realignment or stabilization processes were performed, as suggested in some recent publications.<sup>14</sup>

We believe that the abnormal cartilage

development, associated with bone hardening taking place during adolescence, may mean that it is not present before adolescence, when the costal capsule is cartilaginous and not fibrous, and the process of ossification of the costal cartilage has not intensified.<sup>15</sup>

Finally, this pediatric series describes the need to include slipping rib syndrome among the causes of chest pain in children and adolescents, considering the differences from adults, because the consequences for these patients may be devastating. ■

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