

# Unexpected Salter-Harris type II fracture of the proximal phalanx of the second toe: a chiropractic perspective

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**Objectives:** *To discuss the diagnosis and management of a Salter-Harris type II fracture in a nine-year-old girl who was managed conservatively.*

**Clinical Features:** *A nine-year-old girl fell while playing in bare feet in the grass. She experienced pain when she walked or moved her toe. There was minor swelling and bruising.*

**Intervention and Outcome:** *Plain film radiographs revealed a Salter-Harris type II fracture of the 2<sup>nd</sup> proximal phalanx. Her toe was stabilized and she was referred to an orthopedist. Orthopedic management involved a taping procedure. After three weeks, her fracture healed and she was pain free.*

**Summary:** *Chiropractors may consider radiography of post-traumatic injury sites even with equivocal*

**Objectifs :** *Discuter du diagnostic et de la prise en charge d'une fracture de type II selon la classification de Salter et Harris chez une jeune fille de neuf ans qui a reçu un traitement conventionnel.*

**Caractéristiques cliniques :** *Une jeune fille de neuf ans est tombée alors qu'elle jouait pieds nus dans l'herbe. Elle ressentait une douleur en marchant ou en bougeant son orteil. Des gonflements et des contusions mineurs ont été observés.*

**Intervention et résultat :** *Des radiographies simples ont révélé une fracture de type II de la 2<sup>e</sup> phalange proximale, selon la classification de Salter et Harris. Son orteil a été stabilisé et elle a été aiguillée vers un orthopédiste. La prise en charge orthopédique englobait une procédure de bandage. À l'issue d'une période de trois semaines, sa fracture avait guéri et la douleur avait disparu.*

**Résumé :** *Les chiropraticiens peuvent tenir compte des radiographies des sites des lésions post-traumatiques, même en cas de résultats d'examen équivoques et*

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*examination findings despite histories suggesting seemingly innocuous mechanisms of injury.*

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KEY WORDS: chiropractic, toe fracture, Salter-Harris, pediatrics

### Introduction

The Salter-Harris (SH) classification system is used for fractures involving the growth plate (physis) in children. This system classifies fractures according to the pattern of involvement of the growth plate and surrounding bone as seen on radiographs (Figure 1). Type II fractures are identified by radiolucency in part of the growth plate accompanied by radiolucency of a part of the metaphysis.

Salter-Harris fractures of the toe and fractures in general are not commonly seen or treated in chiropractic practice.<sup>1</sup> However, toe fractures are one of the more common fractures diagnosed by primary care physicians, accounting for 8-9% of fractures seen in primary care.<sup>2,3</sup> Physeal fractures account for 15-30% of all childhood fractures.<sup>4,5</sup> The incidence of such fractures has been reported at a rate of 14 cases per 10,000.<sup>6</sup> Boys are approximately twice<sup>5,7</sup> as likely to have this type of fracture. For girls, these injuries usually occur between ages nine to twelve.<sup>4,7</sup> Brown<sup>8</sup> indicated that 75% of all SH fractures were type

*malgré des récits suggérant des mécanismes de blessure semblant anodins.*

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MOTS-CLÉS : chiropratique, fracture de l'orteil, Salter et Harris, pédiatrie

II; therefore it is the most common physal injury. Fractures of digits two through five are nearly four times more common than fractures of digit one.<sup>2</sup> For all age groups, phalangeal fractures are the most common fractures of the forefoot.<sup>6</sup>

The symptoms of SH II (Salter-Harris type II) fracture can be explained using the mnemonic CC-OPQRSTA (see Table1). These symptoms warrant further physical examination including observation. The skin should be inspected for significant injuries such as “open” wounds that may lead to skin necrosis.<sup>2</sup> A fracture is considered “open” if there is a full thickness laceration around the fracture.<sup>6</sup> Toenails should be inspected for injuries such as subungual hematomas.<sup>2</sup> Deformity of the digit should be noted<sup>2,6</sup> as most displaced fractures and dislocations present with visible deformity<sup>2</sup>. Unfortunately, non-displaced fractures are not as apparent. Most patients with toe fractures have point tenderness over the fracture site<sup>2</sup>, but contusions may also have point tenderness.

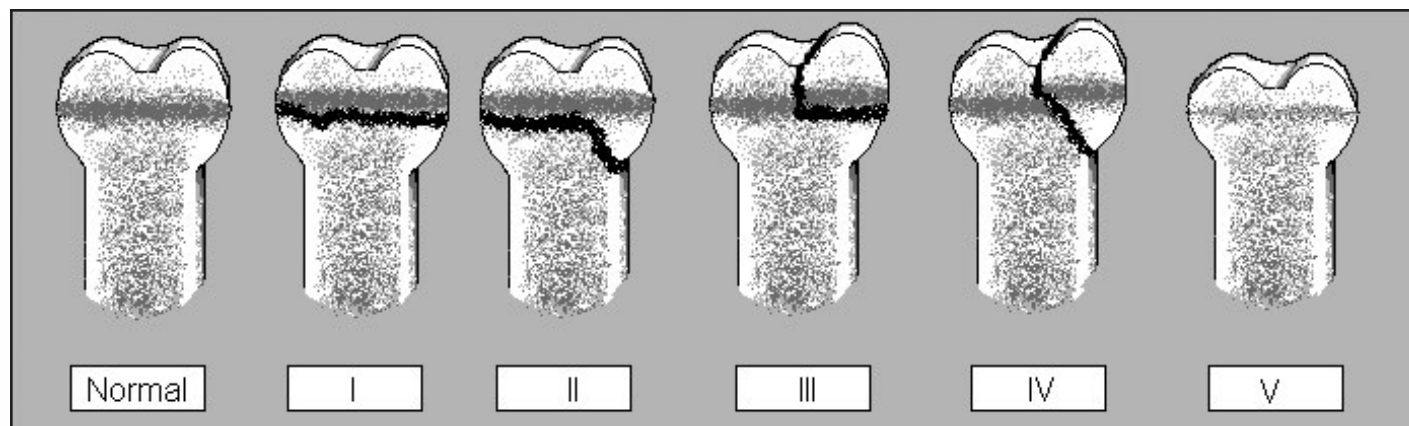


Figure 1.  
*Salter-Harris Fracture Types.*

Table 1.  
Typical symptom pattern for Salter-Harris type II fractures.

CC – Chief complaint	Pain at the fracture site and swelling <sup>2,6</sup>
O – Onset	Bruising normally develops two to three hours after injury. <sup>6</sup> Toe fractures are commonly a result of “axial force (e.g., a stubbed toe) <sup>2</sup> or a crushing injury (e.g., from a falling object)” <sup>2,9</sup> The most commonly associated activities include: assault, motor vehicle accidents, falls (recreation, sports) and striking objects. <sup>6</sup>
P – Palliative and Provocative factors	Relieving factors often include the use of splinting, rest, ice, compression and elevation. Aggravating factors often include movement of the joint, discomfort while wearing shoes, and difficulty walking. <sup>6</sup>
Q – Quality and Quantity of pain	Normally a throbbing <sup>2</sup> ache that becomes sharp with movement. Pain intensity varies from asymptomatic to severe.
R – Radicular or Referred pain	Technically does not apply to toe fractures. Pain distal or proximal to the fracture site can occur due to swelling or damage to adjacent nerves or blood vessels.
S – Site	If present, pain is at the site of injury. <sup>2</sup>
T – Timing	Constant and increased with activity.
A – Associated conditions	Possibly an isolated subungual hematoma. <sup>2</sup> History of a significant mechanism of injury should prompt a lower back and extremity exam. <sup>6</sup>

A thorough neurological and orthopedic evaluation that includes taking pulses and capillary refill, should be conducted.<sup>6</sup> Posterior tibial and dorsal pedis pulses should be evaluated with the understanding that 12% of healthy patients may not have a palpable dorsal pedis pulse.<sup>6</sup> Capillary refill should be assessed while being cognizant that a delay in capillary refill may indicate circulatory compromise.<sup>2</sup> Holding the distal phalanx while applying a gentle, gradual, axial loading force is an important orthopedic maneuver that results in a sharp pain in the proximal phalanx if a fracture site is present, thus differentiating it from a contusion.<sup>2</sup> Uncommonly, tendon injuries may accompany a toe fracture.<sup>2</sup> Muscle injuries can be assessed by first having the patient initiate a very light contraction. Muscle testing may reveal heightened pain with gradual isotonic contraction in the presence of injury. Vibration with a 128 Hz tuning fork may cause heightened discomfort.

The presence of these subjective and objective findings would increase the suspicion of toe fracture. Chiropractic guidelines to determine the necessity of radiography support their use with trauma and findings of injury in adults.<sup>10</sup> However, there is controversy regarding radiography of children as there is concern about unnecessarily exposing children to ionizing radiation. Failure to diagnose a fracture could be harmful if the fractured

fragments are not stabilized. This instability could lead to pain, weight-bearing dysfunction and/or displacement of bone fragments, which could in turn cause apparent or actual toe misalignment. Many cases of missed fracture exist in the literature.<sup>11</sup> With a history of trauma and significant examination findings, consideration of radiography before conservative treatment is important to avoid missing fractures. The objective of this paper is to present a case of a nine-year-old who was found to have a Salter-Harris type II fracture.

### Case Presentation

A nine-year-old child sought chiropractic care for second digit pain three days after she fell while playing barefoot in the grass. She stated that she rolled her toes on the ground. She indicated moderate to severe pain when she walked or when digital pressure was applied to her toe. Using a splint and walking on the lateral edge of her foot decreased the pain, although there was still a constant ache. On examination there was mild swelling of the proximal aspect of the toe as well as antalgic gait. She was unable to walk without pain unless she favoured the lateral side of the affected foot. The alignment of the second digit was unaltered. The second digit was sensitive to applied pressure and slight motion. A tuning fork test mildly increased her pain when compared with no vi-

Figure 2.



2A – DP foot demonstrating fracture of 2nd digit to right foot.

2B – Oblique view demonstrating the oblique fracture with minimal lateral displacement of the distal fragment.

bration. These findings coupled with parental preference led to x-rays being taken.

A radiological series including dorsoplantar (DP), lateral and oblique views of the foot was obtained (Figure 2). A fracture extending from the medial cortex of the metaphysis at the base of the second proximal phalanx into the adjacent physis was noted. There was minimal displacement at the fracture site, although adjacent soft tissue swelling was observed. Bone mineralization was noted to be adequate. Based on these findings, a diagnosis of a Salter-Harris type II fracture was made. The consulting radiologist suggested an orthopedic consultation. In the meantime, the patient's first and second toes were splinted together and she began using a set of crutches.

The patient was evaluated by an orthopedist who recommended taping digit two to digit three with a cotton swab between her toes and wearing a loosely fastened shoe as needed. The orthopedist recommended against the use of crutches. The patient noted that she was pain-free at a three-week follow-up appointment with the orthopedist. Follow-up radiographs demonstrated "excellent callus formation across the fracture. No new displacement is seen and early remodeling is present."

## Discussion

This case involved a nine to twelve-year-old girl with a Salter-Harris type II fracture of the second digit. As such, it resembles the typical demographics for such injuries described in the literature. However, this case was unique due to the unusual mechanism of injury (rolling of her toes in grass), the relative rarity of evaluation of such injuries in chiropractic clinics, and the subtle nature of the complaint. Thus, several issues arise from this case. First, can seemingly minor, unusual events result in a Salter-Harris type II fracture? Secondly, should trauma with modest clinical findings prompt the practitioner to use radiography? Finally, can uncomplicated Salter-Harris type I and II fractures be managed by chiropractors?

In this case, the mechanism of injury was considered unusual as it was not an obvious axial trauma<sup>2</sup> nor a crushing injury.<sup>2,9</sup> The chiropractor initially decided that the mechanism of injury and physical findings did not warrant radiography, but eventually referred the patient due to parental preference. With respect to the literature on the appropriateness of radiography for foot injuries, Bussieres *et al*<sup>10</sup> state that "radiography of the foot for an adult is not required in the absence of metatarsal injury

and normal physical exam". These authors do not indicate a threshold for "abnormal physical exam findings." Axial trauma to the digits of the foot is common and generally has minimal findings without resultant fracture. Therefore, "abnormal physical exam findings" should be clarified. In the present case, the child had minimal physical exam findings including slight ecchymosis, difficulty ambulating, slight swelling, and a mildly positive tuning fork test. Parental preference coupled with those findings suggested a need for performing radiography. In the chiropractic setting, ruling out a fracture is pivotal since a fracture is a contraindication to manual therapy including manipulation.<sup>10,12</sup> Radiographic studies of a suspected toe fracture should include dorsoplantar, lateral, and oblique views.<sup>6</sup> In addition, it is advisable to have multiple opinions on a radiograph for the purposes of risk management.<sup>13</sup> Historically, most SH I or II fractures have been viewed as innocuous injuries.<sup>14</sup> George *et al*<sup>15</sup> state that "the alert emergency physician understands that for many urgent problems the adult and child may differ quite widely in pathophysiology. " Chiropractors should be familiar with classification methods for physeal injuries.<sup>4,15</sup> The Salter-Harris classification is the most accepted.<sup>4,6,16,17</sup> The classification often provides evidence to determine the mechanism of injury.

### *Mechanism of Injury*

The term mechanism of injury (MOI) can refer to the event or the details of the forces involved in the event. According to Armagan and Shereff<sup>18</sup>, an abrupt abduction force is the most common cause of fractures to the lesser toes. More specifically, Brown<sup>8</sup> remarked that SH I and II fractures result from "shearing or avulsion forces that parallel the growth plate." The type of SH fracture is dependent upon mechanism of injury.<sup>19</sup> As per Devalentine<sup>16</sup>, SH fractures occur more often on the metaphyseal side of the growth plate. This helps explain why SH I and II do not normally affect growth.<sup>4</sup> Furthermore, avulsion of small fragments of bone from the phalanges can occur due to the insertion sites of the flexor and extensor tendons. Conversely, these tendons can be injured when a fracture is nearby.<sup>2</sup> Therefore the mechanisms of injury of SH fractures can include shear, crush, avulsion, abduction or axial load. In this case the fracture seems to have been caused by common abduction forces, however the event is unique as many children fall in the grass without result-

ant fractures. As such these mechanisms of injury may result in emergent, complex presentations.

### *Emergency Referral*

Emergency referral following foot trauma may be needed whether or not x-rays have been taken. In some circumstances radiography may be postponed in the interest of a timely emergency referral. Referral to the emergency department without radiography should be performed for patients in significant distress, in shock, with vascular<sup>2</sup> or neurological compromise, obvious dislocation, open fractures or skin necrosis. The latter are at high risk for osteomyelitis.<sup>2</sup> Open fractures of the proximal phalanx are a surgical emergency and immediate orthopedic consultation is recommended to reduce complications, particularly infection.<sup>6</sup> Referral to the emergency room after radiography is necessary for fractures with dislocation or intra-articular involvement (SHIII and IV).<sup>20</sup> Management of the following rare conditions would also require referral to an orthopedist: growth plate closure<sup>14,21</sup>, bony bridge<sup>5,13</sup>, avascular necrosis,<sup>22</sup> persistent pain<sup>20</sup> or malunion<sup>2,20</sup>. For general practitioners, referral is not recommended for children with uncomplicated (closed, non-displaced) SHI and II.<sup>2</sup> However, the chiropractor must be mindful of medicolegal issues such as the consequences of missed fractures<sup>11,23</sup> and their scope of practice with respect to fracture management<sup>24-26</sup>.

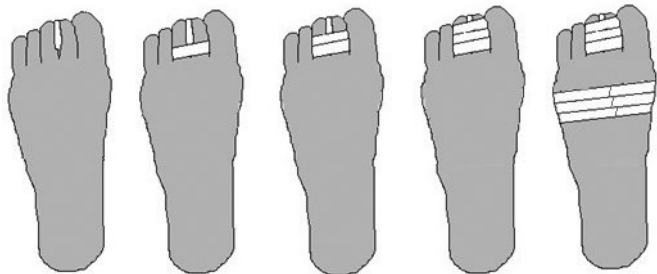
### *Radiograph Necessity*

The application of clinical practice guidelines can help clinicians determine the necessity of radiographic studies.<sup>10,27</sup> Warning signs of severe injury can be summarized by the mnemonic **PUMPS**. Clinicians should assess for the following: history of a **p**op, snap or noises during injury, loss of **u**sability, **m**ode/mechanism of injury, **p**ositional misalignment (may include swelling or bruising), **s**ensation, motor, or vascular loss (pulse, warmth, color and capillary refill). As illustrated in the present case even subtle evidence of these signs could indicate the presence of a fracture.

### *Importance of Foot Fractures for Chiropractors*

Findings related to fractures may be confused with evidence for joint misalignment. According to Burns<sup>28</sup>, a misalignment of the MTP joint will present with loss of fluid motion, point tenderness and a soft tissue callus "over the

Plantar surface



Dorsal surface

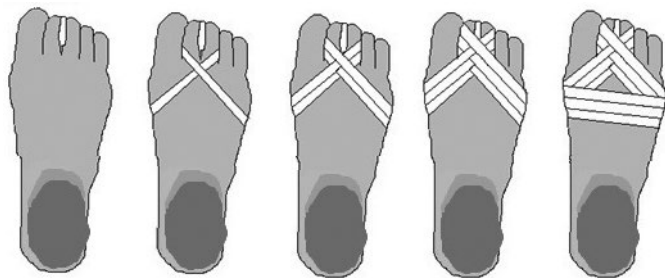


Figure 3.

*Steps for basket weave splinting technique.*

metatarsal head which has dropped” inferiorly. The practical application of this case study is for chiropractors to be aware that minor mechanisms of injury can sometimes cause significant injuries such as fractures. Radiographic assessment should be considered to avoid mistaking a fractured toe for a joint misalignment and then manipulating that fractured toe. Such treatment could result in additional pain and displacement of the fragment. In this case, performing radiographic evaluation of the toe saved the patient from possible displacement of the fracture site and longer healing time if the joint was instead presumed to be misaligned in a chiropractic sense as described by Burns’ criterion.<sup>28</sup>

### ***Management of Uncomplicated Salter-Harris Fractures by Chiropractors***

As chiropractors rarely manage fractures of this nature, additional training beyond traditional first aid training is likely warranted. This training would enhance pre-referral management of SH fractures to orthopedists. Training could include many of the details presented in this

article: demographics, clinical presentation, examination, radiography and treatment. In this case, treatment included using cushioning (a cotton ball) between the toes before applying a splint.<sup>18</sup> This cushioning decreases the chance of pressure sores and helps maintain the normal alignment of the structure. Since the first digit carries a third of the body weight during stance phase,<sup>18</sup> taping digits two and three together is more appropriate than taping digits one and two when digit two is fractured. The splint recommended for lesser digit fractures is a basket weave and buddy combination (Figure 3).<sup>6,29</sup> Prevention of uncomplicated lesser toe fracture includes encouraging the use of shoes during physical play.<sup>9</sup> When either of digits four or five are fractured, using a shoe with a rigid sole for support is recommended if well-tolerated.<sup>18</sup> The shoe can be loosened as needed. Crutches are often not recommended since weight-bearing aids in the healing of the fracture. Moreover, studies suggest that family physicians can manage most toe fractures with good results.<sup>2,20</sup> SH I and II have a low chance of resultant disability.<sup>18</sup> If a review course would be adequate for family practitioners to manage fractures<sup>3</sup>, then chiropractors could potentially learn to manage uncomplicated fractures as well, although it would have to fall within their scope of practice in their respective jurisdiction. This case study raises the question as to whether chiropractors need further education in the management of fractures prior to referral to an orthopedist.

### **Summary**

This case illustrates two main points. Firstly, seemingly minor but unusual mechanisms of injury can result in SHII fractures. Secondly, chiropractors who evaluate patients with toe pain secondary to trauma should consider radiography even with equivocal findings.

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