

# Lacerations and Embedded Needles Caused by Epinephrine Autoinjector Use in Children

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**Study objective:** Epinephrine autoinjector use for anaphylaxis is increasing. There are reports of digit injections because of incorrect autoinjector use, but no previous reports of lacerations, to our knowledge. We report complications of epinephrine autoinjector use in children and discuss features of these devices, and their instructions for use, and how these may contribute to injuries.

**Methods:** We queried emergency medicine e-mail discussion lists and social media allergy groups to identify epinephrine autoinjector injuries involving children.

**Results:** Twenty-two cases of epinephrine autoinjector-related injuries are described. Twenty-one occurred during intentional use for the child's allergic reaction. Seventeen children experienced lacerations. In 4 cases, the needle stuck in the child's limb. In 1 case, the device lacerated a nurse's finger. The device associated with the injury was operated by health care providers (6 cases), the patient's parent (12 cases, including 2 nurses), educators (3 cases), and the patient (1 case). Of the 3 epinephrine autoinjectors currently available in North America, none include instructions to immobilize the child's leg. Only 1 has a needle that self-retracts; the others have needles that remain in the thigh during the 10 seconds that the user is instructed to hold the device against the leg. Instructions do not caution against reinjection if the needle is dislodged during these 10 seconds.

**Conclusion:** Epinephrine autoinjectors are lifesaving devices in the management of anaphylaxis. However, some have caused lacerations and other injuries in children. Minimizing needle injection time, improving device design, and providing instructions to immobilize the leg before use may decrease the risk of these injuries. [Ann Emerg Med. 2015;■:1-9.]

Please see page XX for the Editor's Capsule Summary of this article.

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### INTRODUCTION

The prevalence of anaphylaxis is increasing and the number of yearly fatalities also appears to be increasing.<sup>1-4</sup> Intramuscular epinephrine is the first-line therapy for anaphylaxis and must be readily available to at-risk children to treat symptoms and prevent deaths.<sup>5</sup> Although 3 companies currently market devices for home and community use, the EpiPen and EpiPen Jr (Dey Pharma LP, Napa, CA) are the most widely used epinephrine autoinjectors in the United States.<sup>6</sup> We report 22 cases of lacerations or embedded needles after epinephrine autoinjector use, all caused by EpiPen devices. We furthermore compare features of 3 epinephrine autoinjectors

and make recommendations for device design and instructions for use, which we believe will minimize the risk of similar injuries in the future.

### MATERIALS AND METHODS

#### Study Design and Setting

We queried providers on 2 emergency medicine e-mail discussion lists and members of 8 [Facebook.com](https://www.facebook.com) social media groups related to food allergies, to identify cases of complications of epinephrine autoinjector use in children. Social media groups included a total membership of more than 20,000, with overlap between groups and viewing of messages by a much smaller but not quantifiable number of actively participating members.

**Editor's Capsule Summary***What is already known on this topic*

The key out-of-hospital therapy for anaphylaxis is epinephrine autoinjection.

*What question this study addressed*

Can epinephrine autoinjection devices result in physical injury to children?

*What this study adds to our knowledge*

This study used queries to e-mail discussion lists and social media to identify 18 occurrences of autoinjector-induced lacerations and 4 of retained needles.

*How this is relevant to clinical practice*

Physical injury can occur from epinephrine autoinjectors; refinement of device design and instructions is warranted.

**Selection of Participants**

We included all cases of epinephrine autoinjector injection into a child, resulting in what a treating provider or reporting parent believed matched the description of a laceration or stuck needle. Stuck needles were included only if they required medical attention for removal. We excluded unintentional injections that did not involve these injuries, and cases outside North America.

**Methods of Measurement**

Providers reporting cases reviewed medical records and when possible (all but 2 cases) contacted the families for further details and images. If wound length information was not in the medical record, families were asked for this information. For cases identified on social media, J.C.B. first posted a question asking whether any member had a child with a laceration, stuck needle, or other complication related to epinephrine autoinjector use. When a group member replied and an eligible case was identified, J.C.B. then asked whether she could contact this group member by telephone to obtain further details, estimates of wound length at the time of injury, and images. When possible, wound length was measured according to images, comparing with the length of other objects in the image (adhesive strips or a coin). Otherwise, families gave their best estimate of wound length at the time of injury; if the parent was uncertain, he or she measured the length of the current scar. For parent-identified cases, medical records were not reviewed.

**Primary Data Analysis**

This study is descriptive only and was determined by a hospital institutional review board to be exempt.

**RESULTS****Characteristics of Study Subjects**

Seventeen cases of leg lacerations and 5 other needle-related traumas were identified (Table 1). One provider reported a case of a laceration but no longer worked at the same hospital and did not recall specific details of the patient, circumstances of injury, or specifics of the injury, so the case could not be included. One additional case of an embedded needle met criteria but the providers involved in the case chose to publish separately. One case of a 3-year-old in Australia who experienced a leg laceration after EpiPen Jr use was excluded because it occurred outside of North America.

**Main Results**

Two cases came from the principal investigator's institution. Ten cases were identified from queries on emergency medicine e-mail discussion lists, all from PED-EM-L. Ten additional cases were identified from queries on social media groups, all from the then approximately 9,500-member allergy group No Nuts Moms Group Support Group and Forum. All allergy group members reporting injuries agreed to be contacted by telephone for further details. Seven illustrative cases are presented here and all included cases are summarized in Table 1. Additional figures are published online (cases 4 through 14; Figures E1-E11, available online at <http://www.annemergmed.com>).

**Case 1.** A 4-year-old boy had an allergic reaction at daycare. A staff member restrained the standing child from behind. A second staff member held his leg and administered an EpiPen Jr dose in his right thigh. The child kicked his leg, resulting in a laceration and expulsion of the needle. The staff member immediately reinserted the same needle in an effort to complete the recommended 10-second administration period, resulting in a second laceration (Figure 1). Radiographic imaging and subsequent inspection of the needle revealed that it was bent (Figure 1). He had two 8-cm right-thigh lacerations requiring repair with sutures and adhesive strips, with the child under sedation (Figure 1).

**Case 2.** A 6-year-old boy developed anaphylaxis to fire ant bites. Four providers (the emergency department [ED] attending physician, bedside nurse, resident physician, and the patient's physician-parent) attempted to restrain the child while the attending physician administered an EpiPen

**Table 1.** Features of the patients involved in EpiPen-related injuries.

Case No. (Figure No.)	Weight, kg	Age, Years	Sex	Year	Place of Injury	Known Allergies	Exposure	Autoinjector	Administrator	Site Given	Site Clothing	Complication	Management
1 (1)	13	6	M	2014	Daycare	Peanut	Unclear	EpiPen Jr	Daycare provider	Lateral thigh	Bare skin	Two lacerations, both 8 cm	Repair (NS, T, B)
2 (2)	29.5	6	M	2014	Playground	None	Fire ants	EpiPen	Emergency attending	Lateral thigh	Bare skin	2 lacerations, 8 and 3 cm	Repair (AS)
3 (3)	17	3	M	2014	Daycare	Peanut, tree nut	Cookie	EpiPen Jr	Daycare provider	Lateral thigh	Bare skin	Laceration, 4 cm	Repair (NS)
4 (E1)	11	1	M	2014	Home	Peanut	Soup containing soy	EpiPen Jr	Mother	Lateral thigh	Bare skin	Laceration, 7 cm	Repair (B)
5 (E2)	7	1.3	M	2012	Restaurant	Peanut, egg, and dairy	Unclear	EpiPen Jr	Mother	Lateral thigh	Bare skin	Laceration, 3 cm	Topical antibiotic, dressing
6 (E3)	21	8	M	2014	Home	None	N/A	EpiPen Jr	Patient (accidental)	Tibia	Bare skin	Stuck needle	Injected anesthesia and removal
7 (E4)	19	8	M	2014	Clinic	Multiple	Immunotherapy	EpiPen Jr	Pediatrician	Lateral thigh	Bare skin	Laceration, 5 cm	Repair (T,B)
8 (E5)	13.7	3	F	2011	Home	Egg	Raw egg	EpiPen Jr	Mother	Lateral thigh	Bare skin	Laceration, 3 cm	Repair (B)
9 (E6)	13	3.5	M	2012	Home	Multiple	Unclear	EpiPen Jr	Mother	Lateral thigh	Bare skin	Laceration, 7 cm	Topical antibiotic, dressing
10 (E7)	15	4	M	2006	Home	Peanut	Halloween candy	EpiPen Jr	Mother/nurse	Lateral thigh	Pajamas	Laceration, 5 cm	Topical antibiotic, dressing
11 (E8)	17	3	M	2013	Home	Sesame	Tortilla chips	EpiPen Jr	Mother	Lateral thigh	Bare skin	Laceration, 2.5 cm	Dressing
12 (E9)	15	2	M	2012	Party	Peanut, egg	Halloween candy	EpiPen Jr	Mother	Lateral thigh	Bare skin	Laceration, 2.5 cm	Dressing
13 (E10)	14.5	3	M	2014	Home	Peanut	Lentil soup	EpiPen Jr	Mother	Lateral thigh	Bare skin	Laceration, 1.5 cm	Dressing
14 (E11)	48	11	M	2013	Car, after sports	Peanut	Unclear, possible contact	EpiPen	Mother	Lateral thigh	Thin nylon pants	Laceration, 2 cm	None (not noted until days later)
15	17	5	M	2014	Home	Peanut	Peanut butter cup	EpiPen Jr	Medics	Lateral thigh	Jeans	Laceration, 4 cm	Repair (T)
16	33	8	M	2014	Home	Multiple	Protein shake	EpiPen	Father	Lateral thigh	N/A	Multiple lacerations	Dressing
17	12	2	M	2006	Home	Peanut	Brownie	EpiPen Jr	Mother	Lateral thigh	Bare skin	Laceration, 5–6 cm	Repair (B)
18	10.6	2	M	2008	Daycare	Peanut	Peanut butter sandwich	EpiPen Jr	Mother/nurse	Lateral thigh	Bare skin	Laceration, 2 cm	Dressing
19	18	5	M	2014	N/A	Peanut, dairy	Smoothie containing walnuts	EpiPen Jr	Nurse	Lateral thigh	Bare skin	Stuck needle	Intranasal midazolam sedation and removal
20	20	6	M	2005	School	Peanut	Cookie	EpiPen	Teacher	Deltoid	Bare skin	Stuck needle	Ketamine sedation and removal
21	18	5	M	2013	N/A	N/A	N/A	EpiPen Jr	Nurse	Lateral thigh	Bare skin	Laceration of nurse's digit	Dressing
22	N/A	N/A	F	2011	N/A	N/A	N/A	EpiPen Jr	Nurse	Lateral thigh	Bare skin	Stuck needle	Injected anesthesia and removal

NS, Non-absorbable suture; AS, absorbable suture; T, tissue adhesive; B, steri-strips or butterfly bandages.



**Figure 1.** Case 1: Two EpiPen Jr–associated right-thigh lacerations shown before repair, immediately after repair, and 3 weeks after repair. Also shown is the used device, which appeared normal externally, but a radiograph and dissection revealed that the needle was bent.

Jr dose in the child’s right thigh. On injection, he kicked his legs vigorously and broke through the restraint, dislodging the device. The physician immediately reinserted the same device slightly medial to the first injection site and the child continued to kick his leg during the second injection. Afterward, the child had 2 superficial, confluent lacerations in the shape of a Y, requiring repair with sutures, under sedation. This needle was also found to be bent (Figure 2).

**Case 3.** A 3-year-old boy developed anaphylaxis at daycare. A staff member administered an EpiPen Jr dose in the child’s left thigh. The patient jerked his leg and sustained a 4-cm laceration (Figure 3). The daycare provider then lay over the child and reinjected the same device into his leg in an effort to complete the 10-second administration period. At some point, he sustained a second superficial laceration proximal to the first. The first laceration required repair with sutures, with the child under sedation (Figure 3).

**Case 4.** A 15-month-old boy developed anaphylaxis after eating soup. The child was sitting on the floor. His mother sat next to him, grabbed his left leg with her left hand, and administered the EpiPen Jr dose with her right

hand. On injection into his left thigh, he jerked his leg and sustained an approximately 4.5-cm laceration across his thigh (Figure E1, available online at <http://www.annemergmed.com>). When the needle was removed, it was bent and only partially covered by the needle cover. A second EpiPen Jr dose was administered because of concerns that the medication had not been delivered. The laceration was repaired with adhesive strips and has a scar 1 month later (Figure E1, available online at <http://www.annemergmed.com>).

**Case 5.** A 16-month-old boy developed anaphylaxis after eating at a restaurant. While holding her son on her left hip, his mother held an EpiPen Jr with her right hand and administered the dose with a push-and-hold approach. He initially did not react to the injection, but after a few seconds, he became more responsive and began to kick his leg, resulting in a 3-cm laceration of his left thigh. The needle became stuck “like a hook” under his skin and his mother was initially unable to remove it. She had to insert it more deeply to finally work it free. On removal, the needle was curved and uncovered (Figure E2, available



**Figure 2.** Case 2: Y-shaped EpiPen-associated right-thigh lacerations immediately after repair and 8 months after repair. Also shown is the used device that caused the injury, with a bent needle that blocked the needle cover from covering it.

online at <http://www.annemergmed.com>). The laceration was not repaired and healed with a long, thin scar.

**Case 6.** A 5-year-old boy found his older cousin's EpiPen on the floor in his house and accidentally injected himself in the right medial ankle (Figure E3, available online at <http://www.annemergmed.com>). His family and emergency

medical services providers were unable to remove the device at the scene and he was transported to a pediatric ED.

Examination under fluoroscopy revealed that the needle was bent underneath the child's skin. After 1% lidocaine was injected locally, the needle still could not be easily extracted. The proximal end of the needle was cut free from the device



**Figure 3.** Case 3: EpiPen Jr-associated left-thigh laceration before repair, after repair, and 2 weeks later. A second superficial laceration proximal to the first did not require repair.

and the distal tip was manipulated up, poked through the skin, and removed. On removal, the needle was hook shaped, and the needle tip was split and barblike (Figure E3, available online at <http://www.annemergmed.com>). Fluoroscopic imaging demonstrated no residual retained material. No further treatment was required, and the child was discharged.

**Case 7.** An 8-year-old boy had an anaphylactic reaction to immunotherapy injections. His father held his upper body while a clinician restrained the patient's leg at the knee and administered an EpiPen Jr dose in his left thigh. The patient lifted his leg during injection, resulting in a 5-cm laceration, deep to fascia. The needle was inspected afterward and noted to be bent. A second EpiPen Jr dose was administered because of concerns that the medication had not been delivered. The wound was repaired with tissue adhesive and adhesive strips. It healed with a keloid scar (Figure E4, available online at <http://www.annemergmed.com>). Subsequently, the child received a diagnosis of posttraumatic stress disorder and a restrictive eating disorder, avoiding many foods for fear that they might cause another anaphylactic reaction.

Three epinephrine autoinjectors are currently available in North America: EpiPen and EpiPen Jr (hereafter referred to as EpiPen) (Dey Pharma), the generic equivalent of Adrenaclick (hereafter referred to as generic), Auvi-Q (Sanofi-Aventis, Bridgewater, NJ) and Allerject (Sanofi Canada, Laval, Quebec, Canada), the Canadian equivalent of Auvi-Q (both hereafter referred to as Auvi-Q). Each brand is available in both 0.3- and 0.15-mg dosages, as indicated for different weight ranges. We compared these devices with consideration to safety, ease of use, and

portability (Table 2). EpiPen and the generic have a needle that remains fully extended as long as the device is compressed against the thigh, with instructions to hold the device in place for 10 seconds, whereas the Auvi-Q needle self-retracts in less than a second and has instructions to hold in place for 5 seconds, during most of which time the needle is no longer in the thigh. The EpiPen needle (redesigned in 2009) is covered on removal from the thigh, whereas the generic needle remains uncovered. EpiPen recommends a swinging motion of the arm to activate the device against the thigh, whereas the other devices instruct the user to place the device against the lateral thigh and press. The Auvi-Q is the only epinephrine autoinjector that provides audible instructions during use and has a compact rectangular design. None of the devices include instructions for restraining or immobilizing the thigh during injection.

## LIMITATIONS

The number of physicians and parents who read the queries to identify cases cannot be estimated. The circumstances surrounding the injuries rely on parent and physician recollection of time-pressured and stressful events. Estimates of the length of the wounds may not be accurate. Not all of the devices were analyzed to more consistently report whether or not the needle was bent.

## DISCUSSION

An estimated 5.9 million children in the United States have a food allergy.<sup>1</sup> As the prevalence of food and other

**Table 2.** Comparison of features of autoinjectors.

Characteristic	EpiPen	Generic for Adrenaclick	Auvi-Q/Allerject
Where available in North America	US and Canada	US	US and Canada
Location of safety guard	Opposite needle	Both ends	Needle end
Medication visible before injection	Yes	Yes	Yes
Needle end is labeled	Yes	Yes	Yes
Verbal instructions	No	No	Yes
Rests against thigh before injection	No	Yes	Yes
Needle self-retracts after injection	No	No	Yes
Needle is covered on removal	Yes	No	Yes
Time to needle removal from thigh, if used per instructions, s	10	10	<2
Fits in a typical pocket	No	No	Yes
Second dose available in a single device	No	No	No
Packaged with a trainer device (US)	Yes	No	Yes
Pharmacy wholesale acquisition costs in US* (0.3-mg dose, 2 devices±trainer), \$	428.28	291.59	430.04
Pharmacy wholesale acquisition costs in Canada† (0.3-mg dose, 1 device), \$	89.42	N/A	85.18
Video of 0.3-mg device firing	<a href="http://youtu.be/r6ZkAx7djk">http://youtu.be/r6ZkAx7djk</a>	<a href="http://youtu.be/3xvrBjph89k">http://youtu.be/3xvrBjph89k</a>	<a href="http://youtu.be/d3PntHvNiTY">http://youtu.be/d3PntHvNiTY</a>

\*At Seattle Children's Hospital (Seattle) in 2015.

†At Stollery Children's Hospital (Edmonton) in 2015.

allergies increases in children, so does the risk of anaphylaxis. Devices for the administration of epinephrine at home and in the community are increasingly necessary, and potentially lifesaving.<sup>7,8</sup> In 2013, EpiPen held 93% of the epinephrine autoinjector market share in the United States, and sales had increased 4-fold from 2008.<sup>6</sup>

Our unique means of identifying cases may underestimate the frequency of these injuries but has nevertheless illuminated an issue not identified by other means, such as conventional reporting to the Food and Drug Administration (FDA). To our knowledge, none of these cases had previously been reported, and no other cases of laceration were found by searching for the 3 device names with search engines for FDA MedWatch (<http://www.fda.gov/safety/medwatch/default.htm>), the FDA Manufacturer and User Friendly Device Experience (MAUDE) database (<http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfMAUDE/Search.cfm?smc=1>), or the Institute for Safe Medication Practices (<http://www.ismp.org>). There were 2 other cases of stuck EpiPen needles reported to FDA MAUDE, which did not match the details of our cases.

Epinephrine autoinjectors should be designed to ensure that epinephrine can be administered by nonmedical caregivers promptly, safely, and reliably.<sup>9</sup> Children provide a particular challenge because they may be unable or unwilling to cooperate with this unplanned, painful injection. Even young children may be able to kick their leg free of restraint by providers and parents. To ensure successful and safe administration, the particular needs of children must be considered during the development of these devices and their instructions for use. We believe that the following circumstances are likely to decrease epinephrine autoinjector-associated injuries in children:

1. The child's leg should be immobilized. None of the epinephrine autoinjectors marketed in the United States have prescribing information with instructions to immobilize the leg before use, including the 0.15-mg dosage forms of these devices, which are designed for use in smaller children. Whenever possible, a child should be well restrained during injection to minimize any leg movement during medication administration and to prevent leg lacerations, bent needles, or other injuries to the child or to the person administering the medication. Parents should receive detailed training from providers and pharmacists to ensure they are aware of how to administer the medication safely and appropriately, including how to restrain their child effectively.
2. The action of administering epinephrine and site of delivery should be as well controlled as possible. Patient instructions for the EpiPen direct the user to "swing and firmly push" the device against the thigh. Because both

the person manipulating the device and the patient may be moving, this likely creates a less stable administration environment than holding the device against the thigh and applying pressure until it fires. Only 2 to 8 pounds of pressure are required to fire the device.<sup>10</sup> Because the swing approach is likely to exceed the required activation forces, it may also result in increased pain and therefore distress during administration in children and thereby increase patient movement. In addition, the swing and push approach may seem more threatening to a child. Holding an EpiPen device against the leg and then removing the cap and compressing has been described as an alternate technique to ensure correct placement and minimize upside-down use.<sup>11,12</sup> This technique may additionally create a safer injection environment for the distressed child and would be similar to the instructions for other devices that require similar activation forces.<sup>10</sup>

3. The needle should remain inserted in the thigh for as short a time as possible. Instructions for EpiPen and the generic indicate that the device should be held firmly against the thigh for 10 seconds. During this time, the needle remains fully extended in the thigh, providing an opportunity for needle-related injuries to occur. Our cases show that a device may cause injury even when apparently fired correctly, used by medical providers, and with attempts to restrain the patient. Some of the injuries occurred toward the end of the 10-second hold. Our videos of devices firing (Table 2), as well as information provided to the FDA by Meridian Laboratories, demonstrate that epinephrine is expelled from an EpiPen rapidly on activation.<sup>13</sup> The average duration of medication administration is 0.2 seconds for both EpiPen and EpiPen Jr.<sup>10</sup> In nearly every instance, the full dose is delivered within 3 seconds.<sup>13</sup> A novel study by allergists injecting EpiPen epinephrine into slabs of steak indicated that the medication was delivered as effectively when the device was held in place for 1 second as when it was held for 10 seconds.<sup>14</sup> The Auvi-Q has a needle that self-retracts in less than 2 seconds, and medication delivery with this device is 0.1 seconds, similar to that with EpiPen (personal communication, William Daley, MD, MPH, Sanofi, August 2015). The Auvi-Q device instructs the user to hold it in place for 5 seconds in the interest of ensuring good administration technique, but during the final 3 seconds, the needle is no longer in the child's thigh and is safely housed in the device. In 4 cases in this series, a second EpiPen device was used because the original device had been held less than 10 seconds, resulting in uncertainty that the full dose had been delivered. Given the evidence that epinephrine is rapidly expelled from epinephrine autoinjectors, manufacturers

should reevaluate the need for and safety of the 10-second hold time. In the event of early expulsion of the device, routine repeated epinephrine autoinjector use is likely unnecessary if the device was held for at least 3 seconds, and risks overdosing the patient.

4. The needle should be strong enough that it does not bend during use. Although a small-gauge needle is ideal to minimize pain, in many of our cases the EpiPen needle was bent. Other cases of bent needles have previously been reported to the FDA through MedWatch reporting. Reasons for bending could include a needle made from weak metal, a needle that is not firing straight out of the device, a needle that deflects off heavy material such as a seam, or a device that is being torqued away from 90 degrees during administration. The pen shape of many epinephrine autoinjectors may be conducive to bending because the device can be torqued away from the ideal 90-degree delivery angle in a 360-degree radius. The rectangular shape of the Auvi-Q device restricts bending to 2 directions in a single plane. This design may reduce the chance of needle bending during use. Epinephrine autoinjector manufacturers should take steps to maximize needle strength within the constraints of an acceptable needle gauge, ensure that it fires straight out of the device, and minimize opportunities for bending during use.
5. The needle should never be reinserted. Although the EpiPen never-see-needle cover is designed to lock into place when the device is removed from the thigh, this may not occur if the needle bends during use. In 3 of our laceration cases, the person manipulating the device made the split-second decision to reinsert the same needle in an effort to complete the 10 seconds they believed was required for full medication delivery. This resulted in 3 additional injuries, including 2 significant second lacerations. For improved safety, instructions for devices without self-retracting needles (EpiPen and generic) should include a warning to never reinsert an epinephrine autoinjector needle if it is removed from the thigh prematurely.

Although we believe that improvements in device design and instructions for use could reduce epinephrine autoinjector-associated injuries, we suggest that such an evaluation be undertaken by qualified design, ergonomic, and usability professionals to ensure that these improvements result in increased patient safety as anticipated.

In summary, epinephrine is a potentially lifesaving therapy, and epinephrine autoinjectors must be readily available to children at risk for anaphylaxis.<sup>15</sup> Many parents are reluctant to use an epinephrine autoinjector when needed, resulting in increased morbidity and risk of

death.<sup>16,17</sup> The injuries reported here are rare and should not deter users from administering epinephrine for symptoms suggestive of anaphylaxis. The importance of these injuries lies in the potential for improved epinephrine autoinjector design and better instructions for use, which may diminish the risk of these injuries. Children who are likely to move during administration should be appropriately restrained. Devices prescribed for use in children should have needles that are removed from the thigh promptly after medication delivery and a design otherwise conducive to safe, successful administration in a time-constrained, stressful setting.

*For additional cases see Appendix E1 (available online at <http://www.annemergmed.com>).*

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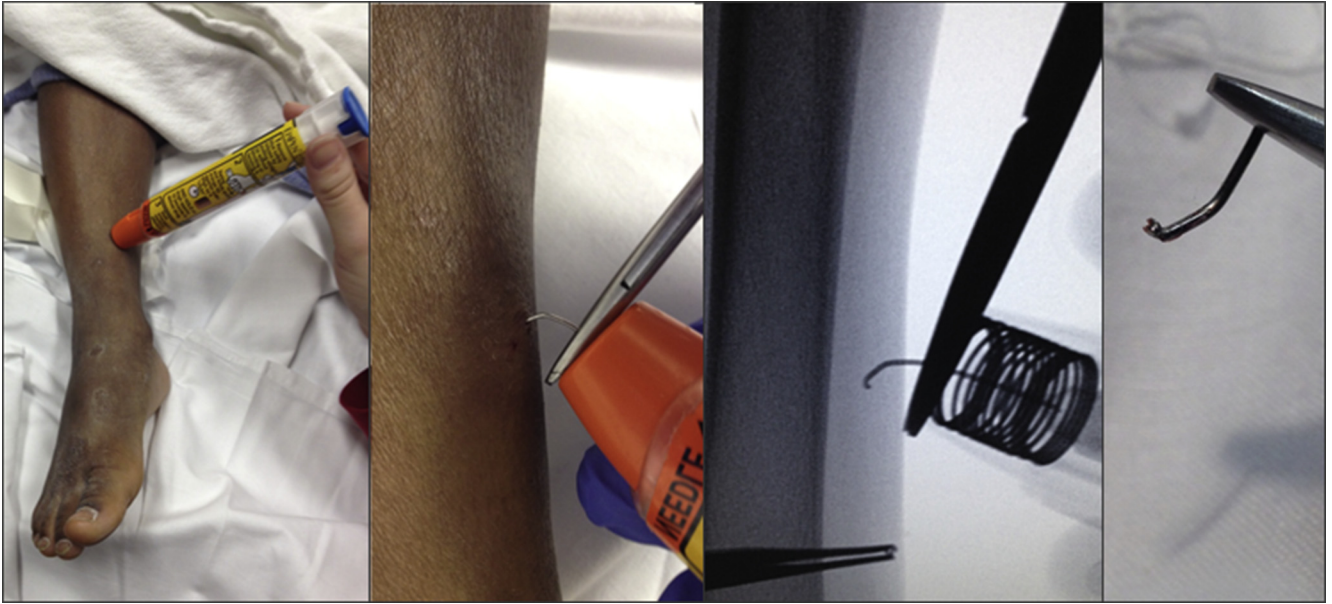
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**Figure E1.** Case 4: EpiPen Jr–associated left-thigh laceration after repair and 1 month later. Also shown is the used device that caused the injury, with a bent needle that blocked the needle cover from covering it.



**Figure E2.** Case 5: An EpiPen Jr–associated left-thigh laceration at the injury, and the scar more than a year later. Also shown is the used device that caused the injury, with a curved needle that blocked the needle cover from covering it.



**Figure E3.** Case 6: An EpiPen Jr device embedded in the patient's calf. On fluoroscopy, the device appeared hooked under the skin. On removal, the needle tip was splayed and barblike.



**Figure E4.** Case 7: EpiPen Jr-associated left-thigh laceration after repair and 2 months later.



**Figure E5.** Case 8: EpiPen Jr–associated left-thigh laceration before repair, extracted from a video of the laceration repair.



**Figure E6.** Case 9: A long vertical scar 2 years after an EpiPen Jr–associated left-thigh laceration.



**Figure E7.** Case 10: A healed EpiPen Jr–associated left-thigh laceration 12 years after the injury.



**Figure E8.** Case 11: A keloid scar 18 months after an EpiPen Jr–associated right-thigh laceration.



**Figure E9.** Case 12: A healed EpiPen Jr–associated right-thigh laceration 6 years after the injury.



**Figure E10.** Case 13: A healed EpiPen Jr-associated right-thigh laceration 4 month after the injury. Also shown is the used device, which appeared normal externally, but a radiograph and dissection revealed that the needle was bent.



**Figure E11.** Case 14: A healed EpiPen Jr-associated right-thigh laceration almost imperceptible 2 years after the injury.

## APPENDIX E1.

We identified 3 additional cases after acceptance and processing of the article. These are reported here and summarized in [Table E1](#).

## Case 23

A 3-year-old boy awoke from a nap with symptoms of anaphylaxis. His father was holding a telephone in one hand, capturing his son's respiratory symptoms on video to show medical providers. With the other hand, he administered the EpiPen Jr, using a swing-and-push approach against the bare skin of his son's right thigh. The child was sitting unrestrained on the floor with his legs straight out. He pulled his leg away 2 or 3 seconds into the injection, resulting in an estimated 8-cm leg laceration ([Figure E12](#)). The needle had a sharp bend that prevented the needle cover from sliding into place. The child's symptoms resolved after the injection, and he was taken to the ED for further care. The wound was not repaired and was dressed with a simple bandage. It has a wide, red scar 1 month after the injury ([Figure E12](#)).

## Case 24

A 7-year-old girl developed anaphylaxis at home. She was cradled on her mother's lap so that she lay mostly flat with her legs elevated. The child's mother administered an EpiPen Jr with her right hand, using a swing-and-push approach against her daughter's right thigh while restraining the child's leg just below the knee with her left hand. She held the device in place for 4 seconds, after which her daughter moved her leg and it dislodged, causing a 2.5-cm wound. The needle was covered with the needle cover, but subsequent radiographs and dissection revealed that it was bent ([Figure E13](#)). The child was taken to the ED for further care. The wound was not repaired. It was dressed with a simple bandage by the parent after discharge. A photograph taken 4 days after the injury shows the wound already healing and smaller (1.3 cm). There is also a dark bruise ([Figure E13](#)).

## Case 25

A 2-year-old boy developed anaphylaxis at home. His mother administered an EpiPen Jr with her right hand, using a swing-and-push approach against his bare right thigh. The child was sitting face out in her lap, and she restrained him by wrapping her left arm around his chest and holding his right thigh with her left hand. Toward the end of the 10-second count, he started struggling more, so his mother removed the device early. However, as she withdrew it, the child moved his leg, causing an estimated

**Table E1.** Features of the 3 additional patients involved in EpiPen-related injuries.

Case No. (Figure No.)	Weight, kg	Age, Years	Sex	Year	Place of Injury	Known Allergies	Exposure	Autoinjector	Administrator	Site Given	Site		Complication	Management
											Clothing	Site		
23 (E12)	15	3	M	2014	Home	Peanut	Almond	EpiPen Jr	Parent	Lateral thigh	Bare skin	Laceration, 8 cm	No repair	
24 (E13)	18	7	F	2015	Home	Peanut, tree nut	Go Raw spirulina bar	EpiPen Jr	Parent	Lateral thigh	Bare skin	Laceration, 2.5 cm	No repair	
25 (E14)	10	2	M	2015	Home	Dairy	Dairy	EpiPen Jr	Parent	Lateral thigh	Bare skin	Laceration, 5 cm	No repair	

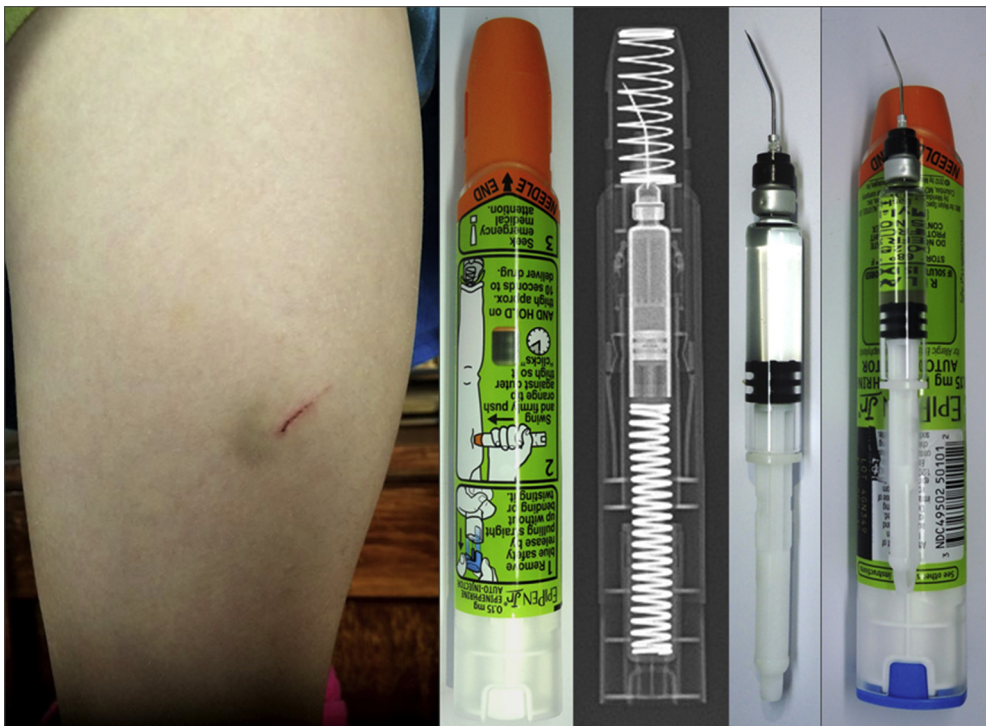
M, Male; F, female.



**Figure E12.** An EpiPen Jr–associated right thigh laceration at injury and the scar 1 month later.

5-cm laceration (Figure E14). The child was taken to the ED for further care. The wound was not repaired and was dressed with a simple bandage. The child was traumatized

by the event and still cries and thrashes whenever his mother approaches the area of injury, even though it appears healed, 6 weeks after the event (Figure E14).



**Figure E13.** An EpiPen Jr–associated left thigh laceration and bruise 4 days after the injury. Also shown is the used device, which appeared normal externally, but a radiograph and dissection revealed that the needle was bent. The needle appears to have bent where it protruded from the device case, as demonstrated in the final image.





**Figure E14.** An EpiPen Jr-associated right thigh laceration 6 weeks after the injury.