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CLINICAL PRACTICE UPDATE—PAEDIATRICS

Paediatric elbow injuries Part 1: Assessing the elbow, identifying and managing a pulled elbow

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Summary This is the first article of a two part series to address simple elbow injuries in children. It will focus on assessment of the injured elbow, addressing techniques to overcome the challenges of examining young children and the features indicative of significant injury in this age group. A case study will be used to illustrate the most common features of a pulled elbow and how this injury is managed. The second article in the series will concentrate on the differences between children's and adults' bones, the radiographic features that are unique to the paediatric elbow and supracondylar fractures.

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Case study

Daisy is a two-year-old girl who presents to the emergency department (ED) with reluctance to use her right arm since yesterday afternoon. She fell off the bottom of a playground slide after her brother slid down knocking her off. Daisy is happily playing, but is not using her affected arm. She is holding her elbow in extension and her forearm is slightly pronated. Her elbow is not swollen and there are no bruises

or grazes. She complains that her arm is sore but there is no bony tenderness on palpation. Daisy tolerates some flexion at the elbow but becomes very distressed with supination or pronation of the forearm. Daisy presents with some common features of a pulled elbow. However, there are several findings which are not considered classic for this injury.

Introduction

A pulled elbow is a common injury in children and represents a significant proportion of childhood injuries presenting to emergency departments (EDs).¹ The elbow is a complex joint made even more complicated by the changes that occur as a result of growth and development of the musculoskeletal system. Children sustain different injuries to adults and

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Figure 1 In pulled elbow the annular ligament around the radial head (left) is dislodged when the arm is pulled (middle), partially dislocating into the radiocapitellar joint when the arm is released (right).

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the signs and symptoms may be more subtle. Furthermore, young children are frequently uncooperative making examination difficult.

This paper will address a common elbow injury in young children. It will focus on examination of the elbow and help the clinician to identify and manage a pulled elbow. Part two in this series will focus on the differences between children's and adults' bones, the radiographic features unique to the paediatric elbow and assessment and management of supracondylar fractures.

Orthopaedic injuries in children are unique for many reasons. The physiological differences of the child's skeleton from that of the adult lead to distinctly different mechanisms of injury, fracture patterns, treatment and healing.² Like mechanism of injury, the age of the child can be used to predict injury as some injury patterns are typical of certain age groups. Each age group from infancy through to adolescence has its own typical injury patterns which one should be able to anticipate.²

The elbow joint is composed of three individual bones contained within a common articular cavity. Articulation of these bones creates two joints and allows motion in the transverse and the sagittal planes.³ The ulnohumeral joint is a hinge joint, which allows flexion and extension of the elbow whereas the radiohumeral joint is a pivoting joint which allows pronation and supination of the forearm.⁴ There is a network of ligaments which helps to maintain stability of the elbow joint. The ligaments of the elbow joint include the ulnar collateral, the radial collateral ligaments and the annular ligament. The annular ligament consists of a band of fibres which encircles the radial head.

Radial head subluxation, commonly known as pulled elbow, or as nursemaids elbow and annular ligament displacement,⁶ has been cited as the most common form of dislocation that occurs in young children.^{5,6} It occurs in approximately 1% of children presenting to EDs each year.⁴

A pulled elbow is displacement of the annular ligament between the capitellum of the distal humerus and radial head¹ (see Fig. 1). This displacement usually occurs as the result of a sudden forceful longitudinal traction on the hand while the forearm is pronated and the elbow is extended.^{1,11}

This pulling mechanism occurs commonly in young children where the arm is pulled while a parent is trying to prevent a fall or where the forearm is pulled while a child resists. Although it is most often caused by a person forcibly pulling on the child's arm, parents may describe a low velocity fall or the mechanism may be unknown.¹² In approximately 50% of cases there is no history of a pull on the arm.⁷ Furthermore, on many occasions the injury is not witnessed and the child is too young to give a good history.⁸ A transverse tear of the thin, relatively weak distal attachment of the annular ligament to the radial neck occurs and the radial head then slides through the anterior portion of the annular ligament.^{4,6} The detached portion of the ligament slips over the radial head into the radiohumeral joint¹ creating a transient subluxation of the radial head.

History

Daisy presents refusing to use her arm and her father says that she has not been distressed unless her elbow is moved, which is the usual presentation for a child with a pulled elbow. Daisy's father reports a fall from a slide. When questioned carefully, Daisy's father says that he did not see exactly how she fell and cannot be sure how she landed. Although a fall increases the likelihood that Daisy has a fracture it does not exclude the possibility of a pulled elbow.

As a two-year old, Daisy is at an age where she is at greatest risk of sustaining a pulled elbow. This injury typically occurs between the ages of one and four years, with a peak incidence between two and three years, although cases have been reported in children younger than six months of age and as old as eight years.^{1,7,9,10} The normal development of the elbow makes this injury unique to young children. The ossification centre of the radial head does not appear until approximately the third to fifth year of life.^{4,11} Prior to its appearance the radial head is more pliable and more likely to slip under the annular ligament.¹¹ As the child gets older the ligament also becomes thicker and stronger and is less likely to be torn and dislodged.^{4,5} This means that as the child gets older more force is required to sublux the radial head.¹¹ Although not clinically helpful, it is interesting to note that it has been reported that girls are more commonly affected than boys.^{7,11}

Examination

Daisy is carrying her arm by her side extended at the elbow with her forearm slightly pronated and is not distressed unless that arm is moved. Children with fractures often look distressed and usually hold the injured arm with the other arm against the body to guard against any movement or jolts.

Examination of children in this age group is often difficult and Daisy is no exception. Children are frequently frightened of hospitals, strangers and the unfamiliar and are anxious about potentially painful treatments. Daisy becomes distressed when approached and is reluctant to cooperate with the examination. She remains on her father's knee while he removes her t-shirt to allow observation before any attempt is made to examine her. This provides the opportunity to observe for obvious deformity, obvious swelling and symme-

try. Clinicians should attempt to gain the child's trust, which may be achieved using distraction techniques such as bubble blowing, to assist with examination. Prior to examining Daisy provision of adequate analgesia and distraction techniques are likely to benefit her as well as assist you with your examination.

Clinical examination should begin with inspecting the unaffected arm which gives an indication of what is normal for the child.⁶ This also shows the child what to expect before you examine the injured arm. Pain may be poorly localised to the site of injury. It is not uncommon for children with a pulled elbow to complain of a sore wrist and forearm. Furthermore, young children often find verbalising and localising their pain difficult thus complicating assessment.⁶ Therefore, a full examination of the affected upper limb from the clavicle to the wrist should be performed.⁵ The limb should be examined for any swelling, deformity, bruising, erythema and breaks in the skin, felt for point tenderness, assessed for neurovascular status and range of movement. Care should be taken not to pronate or supinate the wrist while palpating it as this will cause pain and falsely localise the injury.¹²

There is no deformity and usually no bruising or swelling of the elbow or wrist associated with a pulled elbow. Daisy has the typical build of a toddler making the detection of swelling difficult. As no swelling is visible, her affected limb is felt for fullness comparing it with the unaffected limb. No increase in tension in the tissues of Daisy's injured arm is felt confirming the absence of swelling.

Daisy cries intermittently during the examination of her arm making it difficult to determine whether she is tender or just fed up with being touched. This is a common problem with distressed, uncooperative children. Point tenderness is reproducible so the child should demonstrate a similar response when returning to the same area that elicited a response when previously examined. Watching the child's facial expressions while palpating their arm may also provide clues to the location and extent of tenderness. Daisy shows no signs of tenderness as she does not react consistently to palpation. In a child with a pulled elbow palpation tenderness is usually absent, although there may be point tenderness over the anterolateral aspect of the radial head.⁵

Behaviour and guarding of limbs may also provide clues.⁶ Daisy becomes much more distressed and resistant when her forearm is gently supinated. This is consistent with pulled elbow where children commonly demonstrate marked resistance and pain with supination of the forearm and often become distressed with any elbow movement.⁷

Investigation

The majority of pulled elbows will not require X-ray to confirm the diagnosis.^{3,5,7,13} X-rays of an untreated pulled elbow are typically normal without any evidence of abnormal positioning of the radial head.¹ If the history is not typical and/or the presentation is suggestive of other elbow pathology (e.g. swelling of the elbow, failed attempts at reduction) X-rays are indicated to exclude a supracondylar fracture or radial head fracture.^{1,7,12}

Diagnosis

Pulled elbow is a clinical diagnosis and careful history taking and examination is usually sufficient to confirm or exclude this diagnosis.⁵ In children with failure to use the upper extremity alternative diagnoses such as occult fracture and infection should be considered.³ If the signs are equivocal an X-ray should be requested to exclude alternate diagnoses. Finally, although not common, in the absence of associated pain neurological conditions such as stroke should be considered.³

Daisy's mechanism of injury is a low velocity fall and not classic 'pull' on her arm. However, this does not exclude pulled elbow and her clinical examination reveals no features suggestive of alternative elbow joint pathology and X-ray is not indicated.

Management

A pulled elbow is treated using a simple reduction manoeuvre and in some cases unintended manipulation during triage, dressing or undressing or examination reduces the subluxation. Several reduction manoeuvres have been described to treat a pulled elbow.^{1,5,7,10,13} Reduction of a pulled elbow by nurses must be informed by nursing regulatory scope of practice and performed in accordance with departmental policy and guidelines.

An attempt is made to relocate Daisy's elbow using the pronation/flexion manoeuvre which involves applying pressure over the radial head and fully pronating the extended forearm while gently applying traction then flexing the elbow (see Fig. 2). A click indicating the radial head has slipped back into its normal position is not felt. The click results from release of the trapped annular ligament⁸ and may be felt using either technique.⁴ However it is not always felt when the manoeuvre is successful.⁵ This manoeuvre is attempted first as there is some evidence that it is likely to be the most successful and the least uncomfortable of the two commonly used techniques.^{4,14} After this procedure is performed Daisy is observed for 10 min. As Daisy continues to resist attempts to supinate her forearm it is assumed that this manoeuvre has been unsuccessful. The majority of cases only require a single manipulation.⁴ However, it is not unreasonable to perform two consecutive attempts at reduction if necessary. Therefore, the alternative supination/flexion manoeuvre is attempted where pressure is applied over the radial head while supinating the forearm and flexing the elbow (see Fig. 3). This time a 'click' is felt and Daisy starts to use her affected arm within five minutes.

Children will often resist either supination or pronation of the forearm during this procedure so full range of movement often needs to be forced. In addition, if a 'click' is not felt the likelihood of relocation can be improved by holding the forearm flexed with pressure applied over the radial head. Regardless of the specific technique employed, prior to supinating or pronating it is important to extend the elbow while applying traction.^{12,13} These manoeuvres can be seen in Figs. 1 and 2.

Once the subluxation has been successfully reduced the child usually begins to move his or her injured arm spontaneously within a short time (often 10–15 min).^{10,12,13}

Apply pressure over the radial head

Fully pronate forearm then flex elbow.
(note: flexion is not shown in this picture)

Figure 2 Pronation/flexion manoeuvre to relocate a pulled elbow.

Taken with permission from Pulled Elbow Clinical Practice Guideline, Royal Children's Hospital http://www.rch.org.au/clinicalguide/cpg.cfm?doc_id=5239.

Occasionally children will still not use their affected arm despite the clinician feeling a click over the radial head while performing a reduction manoeuvre. This is more likely if the subluxation is more than 12 h old. In this instance the child should be discharged home with their arm in a sling.^{7,13} A sling will not only give comfort but will also protect the arm from being pulled again.⁸ Normal use of the arm should be expected within a day or two.¹⁰

Where no click is felt and the child continues to complain of pain and refuses to use the arm an hour after reduction manoeuvres are attempted it is likely that the subluxation has not been corrected.¹ Failure may be attributed to improper reduction technique.⁵ However, failure may also occur because of local swelling or a small haemorrhage in the region of the annular ligament⁵ or if reduction is attempted 12 or more hours after annular ligament displacement has occurred.^{1,5} Consultation with a more senior clinician should occur if there have been two consecutive unsuccessful attempts at reduction. The diagnosis should be reconsidered and an X-ray to identify an alternative diagnosis such as fracture may be indicated. If there is no doubt about the diagnosis or it is reconfirmed by a normal X-ray the merits of repeated reduction attempts should be weighed against sending the child home with a subluxation. It may be reasonable to discharge the child home with their arm in a sling for a day or two as it is likely the pulled elbow will resolve without further attempts at reduction.

These manoeuvres are painful and children are rarely cooperative. They are usually best performed with the child

Apply pressure over the radial head

Supinate the forearm

Flex the elbow

Figure 3 Supination/flexion manoeuvre to relocate a pulled elbow.

Taken with permission from Pulled Elbow Clinical Practice Guideline, Royal Children's Hospital http://www.rch.org.au/clinicalguide/cpg.cfm?doc_id=5239.

sitting on their parent's lap. Expect a brief period of distress when performing a reduction manoeuvre, which will quickly resolve once the subluxation has been corrected. If a number of reduction attempts are required it is important to provide adequate analgesia. Nitrous oxide may be used during the reduction attempt to provide analgesia and sedation. It may also make it easier to treat the subluxation as the child is more relaxed and therefore less likely to resist. This is particularly useful if prolonged ligament displacement has occurred or if there have been several attempts at reduction.

Serious complications of pulled elbows are rare and long term complications have not been reported.¹⁰ However, recurrence is common and parents should be informed of this potential. The risk of recurrence is less likely as the child gets older and re-injury can be avoided by not pulling on the arm.¹¹

Daisy is discharged home with her father and her father is provided with verbal and written discharge information, which includes the likelihood of recurrence.

Conclusion

This paper has highlighted some important and unique aspects to assessing the paediatric elbow and has addressed some practical issues associated with identifying and managing a pulled elbow. In Part two of this paper developmental anatomy and normal variants unique to the growing elbow will be discussed in view of assisting the clinician with paediatric elbow X-ray interpretation and management of the supracondylar fracture.

Provenance and conflicts of interest

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