In children 18 years and under, what promotes recurrent shoulder instability after traumatic anterior shoulder dislocation? A systematic review and meta-analysis of risk factors

M Olds, K Donaldson, R Ellis, P Kersten

ABSTRACT
Background Skeletal maturity and age-related changes in the composition of the glenoid labrum and joint capsule may influence rates of recurrent instability in children. We systematically review risk factors which predispose children to recurrent shoulder instability.

Methods The systematic review-concerned studies published before May 2015. Statistical analysis was undertaken to compare rates of recurrence for each extracted risk factor. Pooled ORs were analysed using random effects meta-analysis.

Results 6 retrospective cohort studies met the inclusion criteria. 8 risk factors were identified across the studies including age, sex, shoulder dominance and injury side, mechanism of injury, state of physis closure, and Hill-Sachs and Bankart lesions. The rate of recurrent instability was 73%. Children aged 14–18 years were 24 times more likely to experience recurrent instability than children aged 13 years and less (93% vs 40%; OR=24.14, 95% CI (3.71 to 156.99), Z=3.33, p=0.001, I²=0%). There was a non-significant trend indicating males were 3.4 times more likely to experience recurrent instability (OR=3.44, 95% CI (0.98 to 12.06), Z=1.93, p=0.053, I²=0%). Analysis of one study found that children with a closed physis are 14 times more likely to experience recurrent instability compared with those with an open physis (OR=14.0, 95% CI (1.46 to 134.25), Z=2.29, p=0.02, I²=0%).

Conclusions Male children aged 14 years and over had the greatest risk of recurrent shoulder instability following a first-time traumatic anterior shoulder dislocation. This meta-analysis summarises a mix of acceptable and poor quality level III retrospective cohort studies. Further examination of this population with blinded prospective cohort studies will assist clinicians in the appropriate management of first-time traumatic anterior shoulder dislocation.

INTRODUCTION
Many studies which examine recurrent shoulder instability following a first-time anterior shoulder dislocation do not differentiate skeletally immature children from adult populations, despite the presence of unique pathoanatomical entities such as open physes which can be present until 18 years of age. Rates of recurrent shoulder instability following a first-time traumatic anterior shoulder dislocation have been reported to be as high as 100% in the skeletally immature and 96% in adolescents. Further analysis of the specific risk factors which predispose this subgroup of the population to recurrent shoulder instability following a first-time traumatic anterior shoulder dislocation is warranted.

Factors reported to influence the high rates of recurrent shoulder instability following a dislocation in children include anatomical age-related variances of the shoulder joint, such as a more lateral insertion of the joint capsule on the glenoid, and a higher composition of type 3 collagen fibres. Other proposed factors relating to recurrent shoulder instability in both adults and children include the severity of initial injury, presence of a Bankart lesion, lack of rehabilitation compliance and premature return to high-level activity. While several systematic reviews have investigated the effects of surgical intervention on shoulder instability, none have identified the risk factors of recurrent shoulder instability in a non-operative, skeletally immature population.

The aim of this systematic review was to identify the risk factors associated with recurrent shoulder instability following a first-time traumatic anterior shoulder dislocation in children aged 18 years and under. For the purposes of this systematic review, a recurrent shoulder instability event was defined as either a subluxation or dislocation. We hope that strengthening the evidence will improve clinical decision-making with regard to the management of shoulder instability in children.

METHODS
The development of this systematic review was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol and was registered with the PROSPERO database which can be accessed at http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42013005900#.Uyj7BKISySo. A systematic review and meta-analysis was conducted of the available literature in November 2014 using the following databases; MEDLINE, CINAHL, SPORTDiscus, Scopus, Web of Science, Biomedical Reference Collection, Health and Psychosocial Instruments, AMED, ERIC and Proquest Health and Medical. Five key concepts were used in determining the keywords used in the database search (table 1). Where keywords returned greater than 100 000 titles, the keywords which referred to the shoulder (ie, ‘shoulder’, ‘glenohumeral’ and ‘GHJ’) were contained to search within the ‘title’ field only. Screening of the literature was initially done by title...
and abstract followed by a screening of the full text. The reference lists from the included articles were then analysed to identify any additional articles (Figure 1). Literature not published in English was sent to an external source for translating. Two authors (KD and MO) reviewed potential articles and a consensus was reached regarding included and excluded articles. Inclusion and exclusion criteria for articles are listed in box 1.

The methodological quality of the articles was evaluated using the Scottish Intercollegiate Guidelines Network (SIGN) checklist. While other tools are available for assessing the methodological quality of observational studies, the SIGN checklist is reported to be the most appropriate and valid tool. This assessment tool for cohort study designs covers areas of participant selection, assessment, confounding factors, statistical analysis and overall assessment of the study. The overall methodological quality of each article was graded as being either high quality (+ +) (addressed 7 or more of the 9 SIGN quality appraisal questions), acceptable (+) (addressed 5–6 of the 9 SIGN quality appraisal questions) or low quality (−) (addressed 4 or less of the 9 SIGN quality appraisal questions). Methodological quality appraisal was carried out independently by two authors (MO and KD). If a consensus on methodological quality could not be made, a separate independent author (PK) was used to arbitrate to reach an agreement on the methodological quality results as recommended by the SIGN50 handbook.

Data pertaining to the recurrence rates of shoulder instability were extracted from the included references. These data were pooled to provide an overall instability recurrence rate specific to each risk factor/exposure. Where there were sufficient data to calculate an OR, statistical analyses were performed using the Comprehensive Meta-Analysis program (V2.2.064). Statistical significance was set at 0.05. Statistical heterogeneity between studies was assessed using I². I² is a measure of the heterogeneity of the data, where a value of 0% represents no heterogeneity while values above 75% indicate that high heterogeneity exists.

RESULTS

General study characteristics/demographics
A total of 2385 abstracts were identified following an initial database search, of which 122 articles were potentially suitable after title and abstract screening (Figure 1). Six articles met the criteria for inclusion and exclusion following a full-text screen (Table 1). There were a total of 137 participants included in the review whose age ranged from 4 to 18 years (Table 2). The mean follow-up period was 8.8 years (SD 4.86). The minimum follow-up period was 1 year.

The methodological quality of four articles was rated as acceptable (+) and two articles were low quality (−) (Table 2). All articles followed a retrospective cohort study design which prevented completion of analysis related to selection or attrition bias. Furthermore, all articles failed to mention or attempted blinding of the assessment of recurrent instability from the exposure status. Finally, the two papers deemed low quality, either poorly addressed or did not address the definition of the primary outcome measure of recurrent instability (SIGN Q1.7).

Eight common risk factors for recurrent shoulder instability following a first-time traumatic anterior shoulder dislocation in children 18 years old or younger were identified in the six...
Mechanism of primary shoulder dislocation

The mechanism of injury for first-time traumatic anterior shoulder dislocation was typically divided into two groups: sporting and non-sporting related. Three articles provided results on instability recurrence rates with regard to sporting and non-sporting injuries as an initial mechanism of injury.\(^4\)\(^4\)\(^4\)\(^1\)\(^8\)\(^1\)\(^8\) Pooled data showed that 89.2% (33/37) of participants whose primary mechanism of injury was sporting related had a recurrent instability event, while 76% (19/25) of the non-sporting-related group experienced recurrent instability (table 5). In cases where the mechanism of injury was sporting activity, children were 2.85 times more likely to experience recurrence, compared with when the mechanism of injury was not during sporting activity. This result was not statistically significant but was homogeneous (OR=2.85, 95% CI (0.64 to 12.62), Z=1.38, p=0.17, I²=0%).

Open/closed proximal humeral physis

Four articles provided information on the state (open or closed) of the proximal humeral physis of the affected shoulder at the time of primary anterior shoulder dislocation.\(^1\)\(^3\)\(^4\)\(^1\)\(^8\) Pooled data revealed that 61.1% (39/64) of participants with an open proximal humeral physis at the time of the initial dislocation had a recurrent episode of shoulder instability compared with 94.1% (16/17) of participants with a radiographically confirmed closed proximal humeral physis (table 6). Only one study\(^4\) of the four identified compared open and closed physis. Further analysis of this study indicated that children with a closed physis are 14 times more likely to experience recurrent instability compared with those with an open physis (OR=14.0, 95% CI (1.46 to 134.25), Z=2.29, p=0.02, I²=0%). Again the large variation in CIs reflects the small subject numbers in these studies.
Shoulder dominance

Two of the six eligible articles presented information regarding the side dominance of the shoulder that was initially dislocated.\(^1\)\(^3\) Pooled data illustrated that 83.3% (15/18) of participants whose initial dislocation was on their dominant shoulder experienced recurrent instability. Of those participants who initially dislocated their non-dominant side, 50% (8/16) experienced a recurrent episode of instability (table 7). Calculation of an OR was possible in one study\(^1\) indicating people who have a first-time traumatic anterior shoulder dislocation in their dominant shoulder are 65% less likely to experience recurrence (OR=0.35, 95% CI (0.01 to 8.63), Z=−0.65, p=0.52, \(I^2=0\%)\).

Side of shoulder that was initially dislocated

Three of the six included articles did not report arm dominance but presented information on the side of the shoulder that was initially dislocated.\(^1\)\(^2\)\(^18\) Pooled data showed that 66.7% (14/21) of participants with right shoulder dislocations and 62.5% (15/24) of participants with left shoulder dislocations experienced recurrent instability (table 8). The data show that people who experience a first-time traumatic anterior shoulder dislocation on the right side were 61% less likely to experience recurrent instability. The result was not statistically significant but was homogeneous\(^17\) (OR=0.39, 95% CI (0.065 to 2.42), Z=−1.00, p=0.31, \(I^2=0\%)\).

Hill-Sachs lesion

Radiographic evidence (X-rays and MRI) of the presence of a Hill-Sachs lesion was reported by two studies.\(^2\)\(^18\) Combined data from the two articles illustrated that 100% (13/13) of participants who had radiographic evidence of a Hill-Sachs lesion on their affected shoulder experienced a recurrent instability event. For participants who had no evidence of a Hill-Sachs lesion, 72% (13/18) had a recurrent instability episode (table 9). OR calculations were possible using the data of Postacchini et al\(^2\) indicating that people aged under 18 years with Hill-Sachs lesions were 17.18 times more likely to experience recurrent instability compared with those without a Hill-Sachs lesion (OR=17.18, 95% CI (0.76 to 390.92), Z=1.78, p= 0.07, \(I^2=0\%)\).

Bankart lesion

Two studies reported the presence of a Bankart lesion.\(^1\)\(^2\) Cordischi et al\(^1\) reported that no participants (0/14) had evidence of a discrete labral tear as determined by either MRI or MR arthrogram (MRA) evaluation. Postacchini et al\(^2\) evaluated 12 of the 18 people who had experienced recurrent shoulder instability for the presence of a Bankart lesion. All 12 participants had evidence of a Bankart lesion (table 10). OR calculations were not possible with these data as neither paper made comparisons between children with and without a Bankart lesion.

Table 4 Gender and recurrent shoulder instability

<table>
<thead>
<tr>
<th>Gender</th>
<th>Cordischi et al(^1)</th>
<th>Deitch et al(^2)</th>
<th>Marans et al(^3)</th>
<th>Postacchini et al(^2)</th>
<th>Wagner and Lyne(^18)</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rec</td>
<td>Non</td>
<td>Rec</td>
<td>Non</td>
<td>Rec</td>
<td>Non</td>
<td>Rec</td>
</tr>
<tr>
<td>Male</td>
<td>1/2</td>
<td>1/2</td>
<td>20/25</td>
<td>5/25</td>
<td>14/14</td>
<td>0/14</td>
<td>16/18</td>
</tr>
<tr>
<td>Female</td>
<td>2/12</td>
<td>10/12</td>
<td>4/7</td>
<td>3/7</td>
<td>6/6</td>
<td>0/6</td>
<td>2/3</td>
</tr>
<tr>
<td>Total</td>
<td>3/14</td>
<td>11/14</td>
<td>24/32</td>
<td>8/32</td>
<td>20/20</td>
<td>0/20</td>
<td>18/21</td>
</tr>
</tbody>
</table>

Results indicate the number of recurrent instability events in the total population. Non, no shoulder instability; Rec, recurrent shoulder instability.

Figure 3 Results of meta-analysis of sex and recurrent instability

Table 1 Odds ratios and 95% CI

<table>
<thead>
<tr>
<th>Study name</th>
<th>Odds ratio</th>
<th>Lower limit</th>
<th>Upper limit</th>
<th>Z-Value</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deitch et al, 2003</td>
<td>5.000</td>
<td>0.212</td>
<td>117.894</td>
<td>0.988</td>
<td>0.318</td>
</tr>
<tr>
<td>Postacchini et al, 2000</td>
<td>1.000</td>
<td>0.501</td>
<td>17.564</td>
<td>1.203</td>
<td>0.229</td>
</tr>
<tr>
<td>Wagner et al, 1983</td>
<td>4.000</td>
<td>0.240</td>
<td>66.756</td>
<td>0.965</td>
<td>0.334</td>
</tr>
<tr>
<td>Marans et al, 1993</td>
<td>3.000</td>
<td>0.122</td>
<td>73.642</td>
<td>0.673</td>
<td>0.501</td>
</tr>
<tr>
<td>Cordischi et al, 2002</td>
<td>3.442</td>
<td>0.983</td>
<td>12.057</td>
<td>1.933</td>
<td>0.053</td>
</tr>
</tbody>
</table>

Results indicate the number of recurrent instability events in the total population. Non, no shoulder instability; Rec, recurrent shoulder instability.

Figure 3 Results of meta-analysis of sex and recurrent instability

<table>
<thead>
<tr>
<th>Study name</th>
<th>Odds ratio</th>
<th>Lower limit</th>
<th>Upper limit</th>
<th>Z-Value</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deitch et al, 2003</td>
<td>5.000</td>
<td>0.212</td>
<td>117.894</td>
<td>0.988</td>
<td>0.318</td>
</tr>
<tr>
<td>Postacchini et al, 2000</td>
<td>1.000</td>
<td>0.501</td>
<td>17.564</td>
<td>1.203</td>
<td>0.229</td>
</tr>
<tr>
<td>Wagner et al, 1983</td>
<td>4.000</td>
<td>0.240</td>
<td>66.756</td>
<td>0.965</td>
<td>0.334</td>
</tr>
<tr>
<td>Marans et al, 1993</td>
<td>3.000</td>
<td>0.122</td>
<td>73.642</td>
<td>0.673</td>
<td>0.501</td>
</tr>
<tr>
<td>Cordischi et al, 2002</td>
<td>3.442</td>
<td>0.983</td>
<td>12.057</td>
<td>1.933</td>
<td>0.053</td>
</tr>
</tbody>
</table>

Figure 2 Results of meta-analysis of children aged 14–18 years with those aged 0–13 years

<table>
<thead>
<tr>
<th>Odds ratio</th>
<th>Lower limit</th>
<th>Upper limit</th>
<th>Z-Value</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deitch et al, 2003</td>
<td>11.000</td>
<td>1.483</td>
<td>81.606</td>
<td>2.345</td>
</tr>
<tr>
<td>Postacchini et al, 2000</td>
<td>34.000</td>
<td>1.479</td>
<td>781.787</td>
<td>2.204</td>
</tr>
<tr>
<td>Wagner et al, 1983</td>
<td>3.182</td>
<td>0.115</td>
<td>87.919</td>
<td>0.684</td>
</tr>
<tr>
<td>Lamport et al, 2003</td>
<td>468.333</td>
<td>17.425</td>
<td>12065.670</td>
<td>3.675</td>
</tr>
<tr>
<td>24.136</td>
<td>3.711</td>
<td>156.663</td>
<td>3.332</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Results indicate the number of recurrent instability events in the total population. Non, no shoulder instability; Rec, recurrent shoulder instability.
DISCUSSION

Across the included studies, age has been identified as the primary prognostic factor for recurrent shoulder instability.20–24 The majority of studies appeared to group the paediatric populations as one cohort, thus making it difficult to distinguish those who were skeletally immature. Some studies23 4 have suggested that the 13 and under age group have lower rates of instability following a first-time traumatic anterior shoulder dislocation than children 14 years and older. This review supported these findings and found the 14–18-year age group were 24.14 times more likely to experience recurrent instability than the 13 and under year age group. There are many reasons why this may occur including a more lateral glenohumeral joint capsule insertion at a younger age,5 greater joint capsule elasticity in children younger than 13 years,6 healing potential, capsular versus labral lesions15 and level of activity.26 It is beyond the scope of this review to hypothesise further regarding the presence of increased recurrence in the younger age group.

The state of closure of the proximal humeral physis may relate to the lower recurrence rates found in younger children. Some authors have shown rates of recurrent instability to be as high as 100% in children with an open proximal humeral physis.3 6 27 In contrast, the results of this systematic review revealed a 66.1% recurrence rate in children with an open physis and 91.4% rate in the closed humeral physis group. However, data presented in this systematic review must be interpreted carefully as there were significantly more participants within the closed physis group (n=59) compared with the open physis group (n=17). In addition, rates of recurrence in people aged between 15 and 40 have been reported to be 44%,28 and therefore the presence of variables other than a closed physis must be considered.

Sex has also been proposed to be an important recurrent instability; however, there is discrepancy in the literature. Robinson et al29 used a Cox regression model to predict sex-specific risk factors for recurrent shoulder instability and found males to be at higher risk in all reported ages (15–35 years). Data from Owens et al30 supported these results and found significantly higher shoulder instability rates in males. However, some studies have suggested that sex has no significant effect on recurrent shoulder instability.4 20 24 31 32 This meta-analysis showed an association between sex and risk of glenohumeral instability with males 3.44 times more likely to experience recurrent instability and were near statistical significance (p=0.053).

There is controversy in the literature regarding sporting-related dislocations and recurrence rates. Simonet et al20 found that 82% of people of all ages who initially dislocated their shoulder during athletic activity experienced recurrent instability, which was significantly higher than the non-athletic dislocation cohort (30%; p=0.001). Sachs et al31 reported that people of all ages with sporting-related dislocations were more prone to recurrent instability; however, this trend did not reach a level of significance. In contrast, Kralinger et al21 and Hovelius31 concluded that sporting-related dislocations in people of all ages were not associated with recurrent instability. This systematic review found an 89.2% recurrence rate in sporting-related dislocations and 76% recurrence rate in the non-sporting group. However, these results were not significantly different (p=0.17).

While the relationship between shoulder dominance and instability recurrence has been mentioned in several studies, there appears to be no relationship.1 3 22 24 Te Slaa et al22 and Hoelen et al24 found no differences in recurrence rates for people of all ages following a first-time traumatic anterior shoulder dislocation between dominant and non-dominant shoulders. Cordischi et al,1 Postacchini et al25 and Wagner and Lyne18 also compared recurrence rates between left and right shoulders in children under 18 years of age and found no significant difference. These results support the findings of this systematic review. Recurrence rates were similar between left and right shoulders, 62.5% and 66.7% respectively. The rates between dominant and non-dominant shoulders were 83.3% and 50%, respectively; however, only two articles assessed the relationship between shoulder dominance and recurrent shoulder instability.1 3

Our study was limited by the number of studies which reported pathological lesions. Only two studies4 22 reported

### Table 5: Sporting versus non-sporting mechanism of injury and recurrent shoulder instability

<table>
<thead>
<tr>
<th></th>
<th>Deitch et al4</th>
<th>Marans et al3</th>
<th>Wagner and Lyne18</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rec</td>
<td>Non</td>
<td>Rec</td>
<td>Non</td>
</tr>
<tr>
<td>Sporting</td>
<td>14/17</td>
<td>3/17</td>
<td>12/12</td>
<td>0/12</td>
</tr>
<tr>
<td>Non-sport</td>
<td>10/15</td>
<td>5/15</td>
<td>8/8</td>
<td>0/8</td>
</tr>
<tr>
<td>Total</td>
<td>24/32</td>
<td>8/32</td>
<td>20/20</td>
<td>20/20</td>
</tr>
</tbody>
</table>

Results indicate the number of recurrent instability events in the total number of participants. Non, no shoulder instability; Rec, recurrent shoulder instability.

### Table 6: Open/closed physis at time of injury and recurrent instability

<table>
<thead>
<tr>
<th></th>
<th>Cordischi et al1</th>
<th>Deitch et al4</th>
<th>Marans et al3</th>
<th>Wagner and Lyne18</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rec</td>
<td>Non</td>
<td>Rec</td>
<td>Non</td>
<td>Rec</td>
</tr>
<tr>
<td>Open</td>
<td>3/14</td>
<td>11/14</td>
<td>8/15</td>
<td>7/15</td>
<td>20/20</td>
</tr>
<tr>
<td>Closed</td>
<td>16/17</td>
<td>1/17</td>
<td>16/17</td>
<td>1/17</td>
<td>55/76</td>
</tr>
<tr>
<td>Total</td>
<td>24/32</td>
<td>8/32</td>
<td>20/20</td>
<td>0/20</td>
<td>8/10</td>
</tr>
</tbody>
</table>

Results indicate the number of recurrent instability events in the total number of participants. Non, no shoulder instability; Rec, recurrent shoulder instability.
the presence of a Hill-Sachs lesion following a FTASD. Postacchini et al\textsuperscript{2} reported that all children had a Hill-Sachs lesion and 100% rate of recurrence in these children; Wagner and Lyne\textsuperscript{18} found no Hill-Sachs lesions in the nine children who underwent radiological investigations. Adults with Hill-Sachs lesions were 1.55 times more likely to have recurrent instability following a first-time traumatic anterior shoulder dislocation, although this finding was non-significant (p>0.05) with moderate heterogeneity.\textsuperscript{28} Further investigations are required into the presence of Hill-Sachs lesions and rates of recurrent instability in children following a first-time traumatic anterior shoulder dislocation. With regard to a Bankart lesion, this systematic review found a 100% rate of recurrent instability in children with a Bankart lesion based on one study\textsuperscript{2} of acceptable quality which reported Bankart lesions in all participants. Conversely, Cordischi et al\textsuperscript{1} reported that no Bankart lesions were evident on MRI or MRA. Further evidence from prospective studies which use investigations which have high rates of sensitivity and specificity for detecting Bankart lesions (such as MRA\textsuperscript{24}) is required to establish the association between Bankart lesions and risk of recurrent instability in children aged under 18 years.

There are some limitations to the findings of this systematic review. The methodological quality of the eligible studies was limited as all were level III evidence (retrospective cohort studies). There was no mention in any of the six studies on whether the assessment of the outcome was made blind to the exposure status. Consequently, all articles\textsuperscript{1,4,5,18,19} received ‘low-quality’ ratings due to increased risk of bias. A noticeable strength of this systematic review was the homogeneity of participants in the six included studies. All the participants were recruited from hospitals, under 18 years of age, had radiographic evidence of anterior shoulder dislocation, and were followed for a minimum of 1 year. Furthermore, the risk factors/exposures described in the studies were similar throughout, meaning that common risk factors could be clearly identified. However, the effect sizes of the identified risk factors in this systematic review may have been influenced by confounding variables (such as sample size and participant recruitment) reported across the included studies.

**CONCLUSION**

This systematic review was carried out in order to determine the risk factors associated with recurrent shoulder instability in children aged 18 years and under with a diagnosis of first-time traumatic anterior shoulder dislocation. The common risk factors identified in the six included articles were age at time of initial dislocation, sex, mechanism of initial injury, side and dominance of injured shoulder, state of the proximal humeral physis, and the presence of Bankart and/or Hill-Sachs lesions. As with other studies, age and sex appeared to be the most significant predictors of recurrent shoulder instability. Male children aged 14 years and older appeared to be at the greatest risk of recurrent shoulder instability. This evidence is based on studies deemed acceptable and poor level III evidence, and the strength of evidence in this paper is poor quality level II evidence. Recommendations for future research include carrying out blinded, prospective cohort studies with larger sample sizes in people aged under 18 years in order to provide higher quality research, thus strengthening the evidence base for predicting recurrent instability.
What are the findings?

- Children aged 14 years and older are at risk of recurrent shoulder instability than those aged 13 years and younger.
- As in the adult population, boys with first-time traumatic anterior shoulder dislocations are more at risk of recurrent shoulder instability than girls.
- Children with closed physes are more likely to experience recurrent shoulder instability than children with open physes.

How might this impact on clinical practice in the future?

This paper provides data that can be used to inform children with a first-time traumatic anterior shoulder dislocation, and their parents/caregivers regarding expectations from current conservative management.

- Children aged 14–18 years are more at risk of recurrent instability than their younger counterparts.
- Boys aged 18 years and under are more at risk of recurrent instability than girls.
- Future conservative management strategies need to be developed which are age and sex-specific to prevent recurrent instability following a first-time traumatic anterior shoulder dislocation.
- Further research is required to develop a valid and reliable tool to predict recurrent shoulder instability after a first-time traumatic anterior shoulder dislocation in children aged 18 years and under.

Contributors

MO designed the study, collected and extracted and appraised data, designed the statistical analysis, analysed the data and drafted and revised the paper. KD collected, extracted and appraised the data, analysed the data and drafted and revised the paper. RE monitored data extraction, assisted with methods development, helped draft and revise the manuscript. PK monitored data extraction, assisted with methods development, helped draft and revise the manuscript and adjudicated when consensus was required regarding study inclusions and rating quality.

Competing interests

None declared.

Provenance and peer review

Not commissioned; externally peer reviewed.

REFERENCES


In children 18 years and under, what promotes recurrent shoulder instability after traumatic anterior shoulder dislocation? A systematic review and meta-analysis of risk factors

M Olds, K Donaldson, R Ellis and P Kersten

*Br J Sports Med* published online December 23, 2015

Updated information and services can be found at: [http://bjsm.bmj.com/content/early/2015/12/22/bjsports-2015-095149](http://bjsm.bmj.com/content/early/2015/12/22/bjsports-2015-095149)

These include:

**References**

This article cites 36 articles, 13 of which you can access for free at: [http://bjsm.bmj.com/content/early/2015/12/22/bjsports-2015-095149#BIBL](http://bjsm.bmj.com/content/early/2015/12/22/bjsports-2015-095149#BIBL)

**Email alerting service**

Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

**Topic Collections**

Articles on similar topics can be found in the following collections

- **BJSM Reviews with MCQs** (142)
- **Injury** (904)
- **Trauma** (806)
- **Shoulder instability** (11)
- **Bankart lesion** (48)

**Notes**

To request permissions go to: [http://group.bmj.com/group/rights-licensing/permissions](http://group.bmj.com/group/rights-licensing/permissions)

To order reprints go to: [http://journals.bmj.com/cgi/reprintform](http://journals.bmj.com/cgi/reprintform)

To subscribe to BMJ go to: [http://group.bmj.com/subscribe/](http://group.bmj.com/subscribe/)