

PEER REVIEW HISTORY

BMJ Paediatrics Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

ARTICLE DETAILS

TITLE (PROVISIONAL)	Paediatric elbow fractures and public play spaces: Adherence to standards for children's playground equipment and surfacing
AUTHORS	Smith, Jennifer Chhina, Harpreet Sidhu, Pardeep Brussoni, Mariana Pike, Ian Cooper, Anthony

VERSION 1 – REVIEW

REVIEWER	Reviewer name: Dr. Matt Barry Institution and Country: University Hospital Southampton NHS Foundation Trust, United Kingdom of Great Britain and Northern Ireland Competing interests: None
REVIEW RETURNED	11-May-2021

GENERAL COMMENTS	<p>1) This research has been presented and the results have been published and the authors have not included this in their list of references. I am not sure that this paper adds anything further to their already published research but perhaps the authors can elaborate on that? . Sidhu P, Smith J, Chhina H, Abad J, Lim B, Pike I, Cooper A. PAEDIATRIC ELBOW FRACTURES: PUBLIC PLAYGROUND EQUIPMENT DOES NOT MEET THE SAFETY STANDARD. In Orthopaedic Proceedings 2021 Mar (Vol. 103, No. SUPP_3, pp. 25-25). The British Editorial Society of Bone & Joint Surgery.</p> <p>2) What was the timescale between injury and site visit? Is it possible that in the intervening period there may have been further degradation with continued use by other children and so when the measurements were taken at a point in time after the injury, this might not be a accurate representation of the actual surface depth at the time of injury?</p> <p>3) 27 children fell from a height of more than 2 meters. The authors suggest that the reduced depth of the EWF below the recommended 300mm would effectively increase the height of the fall (page 9, line 21). If the EWF depth had been compliant, how many of the 27 would have still fallen over 2 meters? If the height of the play equipment exceeds 2 meters with the correct depth of the EWF then surely the problem is the height and not the depth?</p> <p>4) Have the authors reported their findings to the relevant British Columbia recreation services and have the authors reviewed the non compliant recreational equipment to determine if it is now compliant? There seems little point in identifying a problem without making efforts to ensure it has been corrected?</p>
-------------------------	--

REVIEWER	Reviewer name: Dr. Eric Kennedy Institution and Country: Bucknell University, United States Competing interests: None
-----------------	---

REVIEW RETURNED	14-Jun-2021
GENERAL COMMENTS	<p>Thank you for presenting this work – the article was well-written and is of particular interest, due to the relative lack of attention given to fracture prevention within current playground safety investigations. I read this article with interest and found the investigation to be a well-conceived approach to collect some information from the injury site that can be linked to the injury outcome. This knowledge will better enable us to have informed discussions and decision-making about mitigation strategies and their effectiveness.</p> <p>As I reviewed the paper, there were several details that came up that I wished for the authors to address. Generally, I do not provide significant line-editing commentary, so as I present my questions, I would appreciate the authors as taking these as global comments on the entire paper and process – rather than constrained to a particular line of a particular section.</p> <p>As much as I liked the concept of a site-investigation of the injury location and link to the injury outcome/ severity, I have a major concern over the presentation of the data in the paper with regard to what the CSA standard *requirement* is. Throughout the paper, the discussion suggests that compliance with the standard is achieved with > 300 mm of surface depth. The CSA standard, however, does *not* specify that 300 mm is required to be maintained in order to satisfy fall height protection requirements. The standard provides an “annex” (informative, non-mandatory) that provides guidance on loose-fill surfacing depth and potential fall height effectiveness, but the specific requirement to satisfy fall height protection is through testing using ASTM F1292 or CEN EN 1177 and achieving < 1000 HIC and < 200 g.</p> <p>My concern is not so much your comparison to the 300 mm surface depth rather than the performance of impact testing, but in the way that the 300 mm surface depth is presented as a requirement. I think the language and description of the CSA standard and the 300 mm must be revised to reflect that the 300 mm depth was used as a “target” or “reference” depth from which the surface conditions and fall height were compared to injury outcome. Surface depth is *not* a pass-fail criterion of the standard.</p> <p>The same is true for the 2 m fall height maximum – again, it is certainly true that many studies (as you pointed out) have suggested 2 m as an important inflection point for more frequent and severe injuries, but the standard does *not* have a hard and fast 2 m fall height requirement, as much as a non-binding recommendation for maximum performance that generalized surfaces can consistently achieve the impact attenuation requirements of the standard (same informative, non-mandatory annex as the 300mm depth recommendation).</p> <p>Relative to the fall height, the paper suggests that “the majority of children fell from heights exceeding the standard, likely reflecting the degradation and compaction of the surfacing material over time.” It may be a more accurate statement to compare these fall heights to the 2 m fall height *suggested* as an important injury threshold from other research papers than to a fall height as *specified* by the standard.</p> <p>Additionally the inference that the additional fall height that is gained by compaction is a challenging claim. Surface compaction could be an interesting point, but I think should involve some discussion of the actual magnitudes of this potential compaction and the effect that it has on fall height. Reviewing Figure 2, a significant amount of data are below 300 mm surface depth (which is part of</p>

	<p>your important findings) but even if we assumed a 50% compaction and loss of material (which by most measures is <i>*quite*</i> high), this would perhaps move a fall height from say 1.9 m to 2.2 m.</p> <p>US CPSC guidelines suggest a 25% compaction allowance (which is actually directly related to the US 12" or Canadian 300 mm depth recommendations, which account for future compaction). It could be that your surface was markedly displaced in the fall area, but that would imply that the surrounding areas have significantly more remaining surface depth. If you're referring to settling and decomposition, can you refine your discussion to detail your thoughts more specifically that the settling of the surface pushes from a safe to an unsafe situation? Is this a realistic claim, that a surface depth of 400 mm compacted to 200 mm and increased the fall height from say 2.0 to 2.2 m? Or that 600 mm of material was compacted to 300 mm and increased from say 1.9 to 2.2 m? I want to follow the discussion, but these situations seem somewhat extreme unless we're talking years and years of neglect, and smaller compaction ratios don't support this claim as strongly. Please elaborate.</p> <p>Please also note that Figure 2 should be reworked with clearer (larger) fonts to be more useful, and is there any discussion related to the trends observed between the severity 1, 2, 3 injuries? Also the term severity 1, 2, 3 from the plot does not seem to match up with the language in the body of the paper Type 1, 2, 3.</p> <p>Overall, this is a very interesting paper. I am intrigued by the linking of the injury and site analysis data – but I am concerned at the framing of this data in context of "meeting" or "not meeting" the standard – as I believe the wording is not precise. I think a few more points should be clarified / cleaned up. Thank you!</p>
--	---

REVIEWER	<p>Reviewer name: Dr. Peter Flom Institution and Country: Peter Flom Consulting, United States Competing interests: None</p>
REVIEW RETURNED	14-May-2021
GENERAL COMMENTS	<p>I confine my remarks to statistical aspects of this paper. These were quite simple, but appropriately so, and I recommend publication.</p> <p>Peter Flom</p>

VERSION 1 – AUTHOR RESPONSE

The research team would like to thank the reviewers for their thoughtful critiques of the paper. Your comments were very helpful and much appreciated.

Editor in Chief Comments to Author:

Title is too long- consider shortening to "Paediatric elbow fractures and public play spaces: adherence to standards for children's playground equipment and surfacing"

RESPONSE: Amended as suggested

What is already known and What this study adds: avoid abbreviations

RESPONSE: This correction has been made

Respond to the points raised by the reviewers

RESPONSE: Please see responses to comments below

Reviewer: 1

Dr. Matt Barry, University Hospital Southampton NHS Foundation Trust

Comments to the Author:

1) This research has been presented and the results have been published and the authors have not included this in their list of references. I am not sure that this paper adds anything further to their already published research but perhaps the authors can elaborate on that? . Sidhu P, Smith J, Chhina H, Abad J, Lim B, Pike I, Cooper A. PAEDIATRIC ELBOW FRACTURES: PUBLIC PLAYGROUND EQUIPMENT DOES NOT MEET THE SAFETY STANDARD. In Orthopaedic Proceedings 2021 Mar (Vol. 103, No. SUPP_3, pp. 25-25). The British Editorial Society of Bone & Joint Surgery.

RESPONSE: Preliminary results from the study were presented at the conference, but the paper offers more detailed analysis and discussion. The reference above is the abstract from that presentation, rather than a full-length paper.

2) What was the timescale between injury and site visit? Is it possible that in the intervening period there may have been further degradation with continued use by other children and so when the measurements were taken at a point in time after the injury, this might not be an accurate representation of the actual surface depth at the time of injury?

RESPONSE: This is a very good point and it is true that we were not always able to conduct measurements of the site immediately after the injury occurred, so further degradation of the surfacing material was certainly possible. We discuss this in the limitations section, page 10, lines 21-25.

3) 27 children fell from a height of more than 2 meters. The authors suggest that the reduced depth of the EWF below the recommended 300mm would effectively increase the height of the fall (page 9, line 21). If the EWF depth had been compliant, how many of the 27 would have still fallen over 2 meters? If the height of the play equipment exceeds 2 meters with the correct depth of the EWF then surely the problem is the height and not the depth?

RESPONSE: We suggest that the problem is more likely to be degradation of the surfacing rather than the height of the equipment itself (in most cases) because fall heights depicted in Figure 2 are clustered around 2000 mm, either just above or just below. While the difference in height above 2000 mm is a little greater than the difference in surface depth below 300 mm for many fracture cases in the Figure, we must also take into account compaction and/or displacement of the surfacing material, which would also reduce its capacity for shock absorption. We discuss this in paragraph 2 on page 9 and have added the following text to address the outliers in the Figure: "In 7 cases, increasing the surface depth to 300mm would still not have made up the difference in height above 2m, but the average equipment height above 2m in this hypothetical scenario would have been less than 5cm (average was 47mm, range from 5mm – 99mm)."

4) Have the authors reported their findings to the relevant British Columbia recreation services and have the authors reviewed the non compliant recreational equipment to determine if it is now compliant? There seems little point in identifying a problem without making efforts to ensure it has been corrected?

RESPONSE: Thank you for this comment, research should be done to be useful! With this publication we plan to approach the city and school boards to open a discussion about how their playgrounds can be made safer without taking away risky play opportunities for children who use the playgrounds. A follow up study to review the effects of changes that are made to the playgrounds (or surfacing maintenance) is the next logical step.

Reviewer: 2

Dr. Peter Flom, Peter Flom Consulting

Comments to the Author:

I confine my remarks to statistical aspects of this paper. These were quite simple, but appropriately so, and I recommend publication.

RESPONSE: Thank you for your comments.

Reviewer: 3

Dr. Eric Kennedy, Bucknell University

Comments to the Author:

Thank you for presenting this work – the article was well-written and is of particular interest, due to the relative lack of attention given to fracture prevention within current playground safety investigations. I read this article with interest and found the investigation to be a well-conceived approach to collect some information from the injury site that can be linked to the injury outcome. This knowledge will better enable us to have informed discussions and decision-making about mitigation strategies and their effectiveness.

As I reviewed the paper, there were several details that came up that I wished for the authors to address. Generally, I do not provide significant line-editing commentary, so as I present my questions, I would appreciate the authors as taking these as global comments on the entire paper and process – rather than constrained to a particular line of a particular section.

As much as I liked the concept of a site-investigation of the injury location and link to the injury outcome/ severity, I have a major concern over the presentation of the data in the paper with regard to what the CSA standard *requirement* is. Throughout the paper, the discussion suggests that compliance with the standard is achieved with > 300 mm of surface depth. The CSA standard, however, does *not* specify that 300 mm is required to be maintained in order to satisfy fall height protection requirements. The standard provides an “annex” (informative, non-mandatory) that provides guidance on loose-fill surfacing depth and potential fall height effectiveness, but the specific requirement to satisfy fall height protection is through testing using ASTM F1292 or CEN EN 1177 and achieving < 1000 HIC and < 200 g.

My concern is not so much your comparison to the 300 mm surface depth rather than the performance of impact testing, but in the way that the 300 mm surface depth is presented as a requirement. I think the language and description of the CSA standard and the 300 mm must be revised to reflect that the 300 mm depth was used as a “target” or “reference” depth from which the surface conditions and fall height were compared to injury outcome. Surface depth is *not* a pass-fail criterion of the standard.

The same is true for the 2 m fall height maximum – again, it is certainly true that many studies (as you pointed out) have suggested 2 m as an important inflection point for more frequent and severe injuries, but the standard does *not* have a hard and fast 2 m fall height requirement, as much as a non-binding recommendation for maximum performance that generalized surfaces can consistently achieve the impact attenuation requirements of the standard (same informative, non-mandatory annex as the 300mm depth recommendation).

Relative to the fall height, the paper suggests that “the majority of children fell from heights exceeding the standard, likely reflecting the degradation and compaction of the surfacing material over time.” It may be a more accurate statement to compare these fall heights to the 2 m fall height *suggested* as an important injury threshold from other research papers than to a fall height as *specified* by the standard.

RESPONSE: Thank you for your comments on the clarity of language regarding both fall height and surface depth. We have accordingly revised the wording throughout the paper as suggested. In instances where the fall height was specified for certain structures, as in Table 2, we have left the wording as-is.

Additionally the inference that the additional fall height that is gained by compaction is a challenging claim. Surface compaction could be an interesting point, but I think should involve some discussion of the actual magnitudes of this potential compaction and the effect that it has on fall height. Reviewing Figure 2, a significant amount of data are below 300 mm surface depth (which is part of your important findings) but even if we assumed a 50% compaction and loss of material (which by most measures is *quite* high), this would perhaps move a fall height from say 1.9 m to 2.2 m.

US CPSC guidelines suggest a 25% compaction allowance (which is actually directly related to the US 12” or Canadian 300 mm depth recommendations, which account for future compaction). It could be that your surface was markedly displaced in the fall area, but that would imply that the surrounding areas have significantly more remaining surface depth. If you’re referring to settling and decomposition, can you refine your discussion to detail your thoughts more specifically that the settling of the surface

pushes from a safe to an unsafe situation? Is this a realistic claim, that a surface depth of 400 mm compacted to 200 mm and increased the fall height from say 2.0 to 2.2 m? Or that 600 mm of material was compacted to 300 mm and increased from say 1.9 to 2.2 m? I want to follow the discussion, but these situations seem somewhat extreme unless we're talking years and years of neglect, and smaller compaction ratios don't support this claim as strongly. Please elaborate.

RESPONSE: This is a very good point and we have clarified that compaction is likely only one factor. It is also possible that displacement of the surfacing material contributed, as many of the popular play structures tended to have grooves worn in the EWF in places where children would climb onto or jump off the structure. It is also possible that some of these playgrounds were not adequately filled to begin with and therefore the surfacing would not necessarily degrade much. We have expanded our discussion in paragraphs 4 & 5.

Please also note that Figure 2 should be reworked with clearer (larger) fonts to be more useful, and is there any discussion related to the trends observed between the severity 1, 2, 3 injuries? Also the term severity 1, 2, 3 from the plot does not seem to match up with the language in the body of the paper Type 1, 2, 3.

RESPONSE: We have revised Figure 2 as suggested. Although we initially expected and looked for trends relating to injury severity, there were none, and we report this on page 7, paragraph 1, lines 8-9.

Overall, this is a very interesting paper. I am intrigued by the linking of the injury and site analysis data – but I am concerned at the framing of this data in context of “meeting” or “not meeting” the standard – as I believe the wording is not precise. I think a few more points should be clarified / cleaned up. Thank you!

VERSION 2 – REVIEW

REVIEWER	Reviewer name: Dr. Matt Barry Institution and Country: University Hospital Southampton NHS Foundation Trust, United Kingdom of Great Britain and Northern Ireland Competing interests: None
REVIEW RETURNED	14-Jul-2021

GENERAL COMMENTS	Thank you for your reply to my comments and for clarifying the nature of your previous publication on this subject. Clearly feedback to the Parks & Recreation department is important.
-------------------------	---

REVIEWER	Reviewer name: Dr. Eric Kennedy Institution and Country: Bucknell University, United States Competing interests: None
REVIEW RETURNED	19-Jul-2021

GENERAL COMMENTS	<p>Thank you for your updates throughout the paper, to each of the reviewer comments. Overall, I'm generally satisfied with the changes to the language regarding the standard language – with one remaining request. While the language no longer explicitly suggests that the surface depth is a given requirement within the CSA standard – but it does suggest this as a recommendation.</p> <p>I'm concerned that this is a case where nuance matters significantly – and what I think is important about your paper, is that your data does support this – impact attenuation performance can vary, and particularly at high(er) fall heights, surfacing must be diligently assessed and maintained.</p> <p>The CSA standard's annex – from which I *believe* you are referring to the 300mm as a recommendation – is *not* meant as a</p>
-------------------------	--

	<p>recommended depth, but rather a guide to aid in understanding of the relative magnitudes of surfacing required and when performance limitations set in. My concern is that without proper context, the standard is presented as having suggested 300mm as a recommended surface depth. Rather, the standard suggests that the anything below 300mm is NOT recommended (it may not say this explicitly, but largely due to the compaction/ erosion concerns that you list).</p> <p>The standard, including the annex with the 300mm minimum recommendation does suggest that the true measure for a surfacing's impact attenuation performance is conducting impact attenuation testing.</p> <p>So, I feel that there are two important considerations that should be clarified within your paper, so that they underscore the significance of your injury-surface condition findings:</p> <ol style="list-style-type: none"> 1) That 300mm is meant to be a minimum *trigger* for recommended maintenance and, 2) It is important to test (or know) the impact attenuation characteristics of the given surface material, so that the maintenance depths that are specific to that material and fall height are known – and can therefore be maintained appropriately. <p>Another long way of making a change request, but I would like to make sure we are on the same page and don't present a misleading narrative that the standard itself presents a target recommendation of 300mm. I think it is an important consideration to educate your audience about this nuance, else we may have a number of individual readers misinterpreting that their target surfacing depth is somehow ratified by the standard.</p>
--	--

VERSION 2 – AUTHOR RESPONSE

Response: We have addressed the reviewer comments throughout the paper and included a tracked changes copy of the manuscript to highlight the specific changes made. Our team is very appreciative of the thoughtful comments we have received and the subsequent improvements to the paper.

Reviewer: 1

Dr. Matt Barry, University Hospital Southampton NHS Foundation Trust

Comments to the Author

Thank you for your reply to my comments and for clarifying the nature of your previous publication on this subject. Clearly feedback to the Parks & Recreation department is important.

Response: Thank you again for your comments to improve the paper.

Reviewer: 2

Dr. Eric Kennedy, Bucknell University

Comments to the Author

Thank you for your updates throughout the paper, to each of the reviewer comments. Overall, I'm generally satisfied with the changes to the language regarding the standard language – with one remaining request. While the language no longer explicitly suggests that the surface depth is a given requirement within the CSA standard – but it does suggest this as a recommendation.

I'm concerned that this is a case where nuance matters significantly – and what I think is important about your paper, is that your data does support this – impact attenuation performance can vary, and particularly at high(er) fall heights, surfacing must be diligently assessed and maintained.

The CSA standard's annex – from which I *believe* you are referring to the 300mm as a recommendation – is *not* meant as a recommended depth, but rather a guide to aid in understanding

of the relative magnitudes of surfacing required and when performance limitations set in. My concern is that without proper context, the standard is presented as having suggested 300mm as a recommended surface depth. Rather, the standard suggests that anything below 300mm is NOT recommended (it may not say this explicitly, but largely due to the compaction/ erosion concerns that you list).

The standard, including the annex with the 300mm minimum recommendation does suggest that the true measure for a surfacing's impact attenuation performance is conducting impact attenuation testing.

So, I feel that there are two important considerations that should be clarified within your paper, so that they underscore the significance of your injury-surface condition findings:

- 1) That 300mm is meant to be a minimum *trigger* for recommended maintenance and,
- 2) It is important to test (or know) the impact attenuation characteristics of the given surface material, so that the maintenance depths that are specific to that material and fall height are known – and can therefore be maintained appropriately.

Another long way of making a change request, but I would like to make sure we are on the same page and don't present a misleading narrative that the standard itself presents a target recommendation of 300mm. I think it is an important consideration to educate your audience about this nuance, else we may have a number of individual readers misinterpreting that their target surfacing depth is somehow ratified by the standard.

Response: Thank you for your thoughtful review of our paper and comments to improve the clarity and precision of the language used throughout. We have made various adjustments to bring the descriptions in line with your suggestions, and these are marked in the tracked changes copy of the manuscript. Again, we are very appreciative of your time and the explanations you provided.