PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Effectiveness of surgical fixation for lateral compression type one (LC-1) fragility fractures of the pelvis: a systematic review
AUTHORS	Booth, Alison; Ingoe, Helen; Northgraves, Matthew; Coleman, Elizabeth; Harden, Melissa; Kassam, Jamila; Kwok, Iris; Hilton, Catherine; Bates, Peter; McDaid, Catriona

VERSION 1 - REVIEW

REVIEWER	Rommens Pol Prof. Dr. Director Department of Orthopedics and Traumatology University Medical Center Mainz Johannes Gutenberg-University Mainz Germany
REVIEW RETURNED	27-Jun-2018

GENERAL COMMENTS	Page 4. Various classifications of the pelvic ring. 1. Young and Burgess: an oblique or transverse ramus fracture with or without ipsilateral anterior sacral alar compression fracture (LC-1): The description you give partially concerns an isolated pubic ramus fracture. Would you consider to treat an isolated anterior pelvic ring fracture operatively? Page 5, lines 17-20. Reference 23 is not referring to external but to internal fixation of the anterior pelvic ring. Page 5, lines 38-44: The lateral compression injury (LC-1) involves a fracture of the anterior pelvic ring and a crush zone or fracture of the posterior pelvic ring. With INFIX, you only stabilize the anterior pelvic ring. Do you mean stabilization is sufficient? When do you recommend fixing the posterior pelvic ring, when the anterior pelvic ring, when both? Page 6: why did you not search for “Fragility fractures Pelvis”? Page 7: the Joanna Briggs Institute Checklist for Case Series. Do you have a reference? After having a look at the four different manuscripts, which are left for your research, (Table 1), it becomes clear that the patients in these studies do by far not all have LC-1 fractures. Some of them have bilateral lesions, some of them chronic instabilities and others FFP Type IV in the Rommens-Hofmann classification. I therefore suggest using the description FFP instead of LC-1 in the title of your manuscript. This description focuses all different types of fragility fractures, which have been treated operatively, which better represents reality. Page 17, line 16: across the five studies… Which five studies?

	After reading this systematic review paper, it becomes clear that there is very little evidence on outcome of different treatment (conservative, operative, external, internal fixation) algorithms of fragility fractures of the pelvis. The authors mean focusing on LC-1 fractures, although a number of other lesions are among the fragility fractures, which have been treated operatively in the four studies described. The difficulty begins with the definition or description of LC-1. It therefore seems logical using one specific classification, which focuses on FFP and clearly distinguishes lateral compression injuries from other types. The authors should support using one language in future research. This also will enable better comparison of results between studies and hospitals. The manuscript clearly shows the lack of evidence in this emerging field of geriatric trauma surgery and therefore deserves publication after correction and revision.

REVIEWER	Dr. med. Andreas Höch Department of Orthopedics, Trauma and Plastic Surgery, University of Leipzig, Liebigstrasse 20, 04103 Leipzig, Germany. The only competing interest is the fact that I am the authors of one of the reviewed studies in the manuscript.
REVIEW RETURNED	04-Jan-2019

GENERAL COMMENTS	Dear Editor, dear authors, thank you for inviting me to review the manuscript „ Effectiveness of surgical fixation for lateral compression type one (LC-1) fragility fractures of the pelvis: a systematic review” With this systematic review you address an interesting topic and question with increasing relevance. Unfortunately only four studies could be included. Below you find my comments and recommendations for the manuscript. Abstract: Participants: for me it is confusing that LC 1 fractures (Young/Burgess) are otherwise known as sacral insufficiency fractures (Lourie H. Spontaneous osteoporotic fracture of the sacrum. An unrecognized syndrome of the elderly. JAMA 1982; 248 (6): 715–717). You have a nice description in your methods, why not just use this Introduction: Good leading into the topic except of the long part about INFIX. Unclear is the definition of FFP II fractures (p5,L8) FFP IIb and c fractures can have bilateral posterior and anterior fractures (Rommens PM, Hofmann A. Comprehensive classification of fragility fractures of the pelvic ring: Recommendations for surgical treatment. Injury 2013; 44 (12): 1733–1744) I do not understand the long part about the INFIX, you should shorten it and consider to mention other techniques available, e.c. augmented screws, transiliac-transsacral screws, sacral bars. Methods: Clear described methods. Good study design. Results: You have given a good and detailed overview of the four available studies. I believe “Hoch et al” is spelled “Höch et al” and “Gansslen et al”. is “Gänsslen et al”)

	Discussion: The found results are discussed appropriately. Nevertheless, the weakness in evidence of only four available studies is pointed out. In some sections there is a spelling mistake with FFS instead of FFP. And again as mentioned before you extensively discuss the INFIX but not other techniques published. I still do not see the relevance of the INFIX to this review. Overall, this manuscript is well worked out from a scientific point of view. Nevertheless, I think the editor should decide in this case whether the relevance and clinical significance is also sufficient for a publication in "BMJ open", since the knowledge gain from the manuscript is small. Sincerely yours

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1 Reviewer Name: Rommens Pol

Institution and Country: Director, Department of Orthopedics and Traumatology, University Medical Center, Mainz, Johannes Gutenberg-University, Mainz, Germany
Please state any competing interests or state 'None declared': None declared

Comments	Author responses
Page 4. Various classifications of the pelvic ring. 1. Young and Burgess: an oblique or transverse ramus fracture with or without ipsilateral anterior sacral alar compression fracture (LC-1): The description you give partially concerns an isolated pubic ramus fracture. Would you consider to treat an isolated anterior pelvic ring fracture operatively?	Unfortunately the orthopaedic bony classification doesn't always fit with the clinical picture and pain perceived by the patient. Therefore, we would potentially consider fixing a pubic ramus fracture if it were preventing the patient from walking or getting out of bed.
Page 5, lines 17-20. Reference 23 is not referring to external but to internal fixation of the anterior pelvic ring.	Apologies, and thank you for spotting this error. The reference has been removed and replaced with: McDonald C, Firoozabadi R, Routt M, et al. Complications Associated With Pelvic External Fixation. Orthopedics 2017;40(6):e959–e963 and Rommens PM, Wagner D, Hofmann A. Minimal Invasive Surgical Treatment of Fragility Fractures of the Pelvis. Chirurgia (Bucharest, Romania: 1990) 2017;112(5):524-37.
Page 5, lines 38-44: The lateral compression injury (LC-1) involves a fracture of the anterior pelvic ring and a crush zone or fracture of the posterior pelvic ring. With INFIX, you only stabilize the anterior pelvic ring. Do you mean	We carried out this review as these are un-answered questions in FFP. In the trial we are now undertaking we have made the fixation pragmatic and allow posterior fixation (along with anterior), as you say. The issue with SI screws

stabilization is sufficient? When do you recommend fixing the posterior pelvic ring, when the anterior pelvic ring, when both?	alone is that the purchase in osteoporotic sacral bone is very poor and unlikely to confer huge benefit. Because INFIX is fixed-angle and not requiring great bone quality to achieve fixation, we wanted to know what evidence there was for its use, and that of other surgical approaches in this population. We have add a sentence and reference to the introduction section to state that INFIX can be used alone or in combination with external fixation methods. (Page 5 "…alone or in combination with external surgical fixation techniques." Reference: Vaidya R, Nasr K, Feria-Arias E, et al. INFIX/EXFIX: Massive Open Pelvic Injuries and Review of the Literature. Case Reports in Orthopedics 2016;2016:1-7.)
Page 6: why did you not search for "Fragility fractures Pelvis"?	Apologies, our list of search terms in the body of the paper is not exhaustive. We did use these terms, please see the example search strategy in Supplementary file 1 where the terms fragility, fracture and pelvis are all covered in all their variations. We have also added these to the example terms given in the text on Page 6 and made clear the list is indicative.
Page 7: the Joanna Briggs Institute Checklist for Case Series. Do you have a reference?	Reference added: The Joanna Briggs Institute. Checklist for Case Series. Joanna Briggs Institute Critical Appraisal tools for use in JBI Systematic Reviews. 2017.
After having a look at the four different manuscripts, which are left for your research, (Table 1), it becomes clear that the patients in these studies do by far not all have LC-1 fractures. Some of them have bilateral lesions, some of them chronic instabilities and others FFP Type IV in the Rommens-Hofmann classification. I therefore suggest using the description FFP instead of LC-1 in the title of your manuscript. This description focuses all different types of fragility fractures, which have been treated operatively, which better represents reality.	We take your point, but our study aims, search strategy and selection criteria were specifically looking for LC-1 fractures in patients with FFP. As detailed in our registered protocol and in the selection criteria section: "Patients with an LC-1 pelvic fragility fracture, sustained as the result of a low energy mechanism, defined as a fall from standing height or less. Where studies include participants with non-fragility LC-1 fractures or other pelvic fractures these will be included if the data are reported separately and/or if 80% or more of participants have an LC-1 fragility fracture." We have therefore excluded studies that would need to have been included if we were looking at FFP rather than LC-1 fractures specifically. We therefore feel it would be misleading to change the title.
Page 17, line 16: across the five studies… Which five studies?	Apologies, this has been amended to say "…across the four studies…"
After reading this systematic review paper, it becomes clear that there is very little evidence on outcome of different treatment (conservative, operative, external, internal	Thank you for your observations. We agree that our review supports a call for consistency in language as well as the use of standardised PROMS in future research in this area. We have

fixation) algorithms of fragility fractures of the pelvis. The authors mean focusing on LC-1 fractures, although a number of other lesions are among the fragility fractures, which have been treated operatively in the four studies described. The difficulty begins with the definition or description of LC-1. It therefore seems logical using one specific classification, which focuses on FFP and clearly distinguishes lateral compression injuries from other types. The authors should support using one language in future research. This also will enable better comparison of results between studies and hospitals. The manuscript clearly shows the lack of evidence in this emerging field of geriatric trauma surgery and therefore deserves publication after correction and revision.	added the following wording to this effect in the discussion (Page 17): “It is clear that there is also a need for consistency in the language and terminology used for describing low impact fractures of the pelvis.[18-22] The existence and use of a number of different classification systems is concerning in terms of understanding decision making processes and the sharing of good practice.”

Reviewer: 2
Reviewer Name: Dr. med. Andreas Höch
Institution and Country: Department of Orthopedics, Trauma and Plastic Surgery, University of Leipzig, Liebigstrasse 20, 04103 Leipzig, Germany.
Please state any competing interests or state ‘None declared’: The only competing interest is the fact that I am the authors of one of the reviewed studies in the manuscript.

Comments	Author responses
Dear Editor, dear authors, thank you for inviting me to review the manuscript „ Effectiveness of surgical fixation for lateral compression type one (LC-1) fragility fractures of the pelvis: a systematic review” With this systematic review you address an interesting topic and question with increasing relevance. Unfortunately only four studies could be included. Below you find my comments and recommendations for the manuscript.	Thank you.
Abstract: Participants: for me it is confusing that LC 1 fractures (Young/Burgess) are otherwise known as sacral insufficiency fractures (Lourie H. Spontaneous osteoporotic fracture of the sacrum. An unrecognized syndrome of the elderly. JAMA 1982; 248 (6): 715–717). You have a nice description in your methods, why not just use this	Thank you for your comment. We found the range of terms in use, and differing preferences a challenge in this review. We take your point but were not sure it was appropriate to include only one of the four anatomical classification systems we give in our methods section. We have therefore amended the Participants section in the abstract to read: “Patients with lateral compression pelvic fractures (LC-1 fractures), sustained as the result of a low energy mechanism, defined as a fall from standing height or less.”

	The point about the need for a consistent set of terms was also highlighted by our other peer reviewer so we have added this as an issue in the discussion (Please see above and Page 17 of the revised manuscript)
Introduction: Unclear is the definition of FFP II fractures (p5,L8) FFP IIb and c fractures can have bilateral posterior and anterior fractures (Rommens PM, Hofmann A. Comprehensive classification of fragility fractures of the pelvic ring: Recommendations for surgical treatment. Injury 2013; 44 (12): 1733–1744)	We are unsure how we can improve clarity here but would be happy to take further comment on this. A direct quote from the Rommens and Hoffman paper reads “The FFP Type IIb and FFP Type IIc lesions correspond with the LC Type I lesion of the Young–Burgess classification” The comment of bilateral injury has not been raised by Professor Rommens who has also reviewed this paper.
I do not understand the long part about the INFIX, you should shorten it and consider to mention other techniques available, e.c. augmented screws, transiliac-transsacral screws, sacral bars.	We have amended the introduction (Page 5) to include reference to the suggested techniques and reduced the emphasis on INFIX. As we say in the introduction, the point of undertaking the review was to identify any literature on the use of surgical techniques particularly because of the development of INFIX as a potentially new way of managing LC-1 FFP. No such review had previously been undertaken. We assumed readers would be familiar with the established surgical approaches but not necessarily with INFIX.
Methods: Clear described methods. Good study design.	Thank you.
Results: You have given a good and detailed overview of the four available studies. I believe “Hoch et al” is spelled “Höch et al” and “Gansslen et al”. is “Gänsslen et al”)	Sincere apologies, we have corrected this throughout the manuscript (highlighted in yellow).
Discussion: The found results are discussed appropriately. Nevertheless, the weakness in evidence of only four available studies is pointed out. In some sections there is a spelling mistake with FFS instead of FFP. And again as mentioned before you extensively discuss the INFIX but not other techniques published. I still do not see the relevance of the INFIX to this review.	Thank you. FFS has been amended to FFP. As explained above our review was specifically looking at the evidence for INFIX in our population given its value shown in younger age groups. We included all surgical approaches to give a broad overview. We have reduced the text on INFIX and added references to other techniques.
Overall, this manuscript is well worked out from a scientific point of view. Nevertheless, I think	Thank you.

the editor should decide in this case whether the relevance and clinical significance is also sufficient for a publication in "BMJ open", since the knowledge gain from the manuscript is small.	We believe the absence of robust evidence is an important finding to put in the public domain because of the nature and size of the clinical problem. The UK age-specific incidence of pelvic fractures has increased from 39.6/100,000 (95% CI: 31.8 to 48.1) in 1997 to 71.61/100,000 (58.4 to 81.0) in 2007-2008 amongst people 65 years and older; 84% of these had pubic rami fractures. This increase is supported by evidence from other countries e.g. in Finland (based on national data) where the incidence, amongst people 60-years and older, has increased from 20/100,000 in 1970 to 92/100,000 in 1997. The estimated median treatment cost of pelvic ring fractures in Europe (acute hospital, surgery, rehabilitation, physiotherapy, and work-related absence) is €33,710 (interquartile range €23,266 to 51,012), which is more costly than hip fractures. [Aprato A, Joeris A, Tosto F, Kalampoki V, Stucchi A, Masse A. Direct and indirect costs of surgically treated pelvic fractures. Archives of Orthopaedic & Trauma Surgery. 2016;136(3):325-30.]

VERSION 2 – REVIEW

REVIEWER	Andreas Höch Department of Orthopedics, Trauma and Plastic Surgery, University of Leipzig, Liebigstrasse 20, 04103, Leipzig, Germany
REVIEW RETURNED	20-Mar-2019

GENERAL COMMENTS	The authors have adequately addressed all suggestions and made the desired changes accordingly. With the changes made, the recommendation for accepting the manuscript is given.