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Review Article

How to Improve the Post-Graduate Training of General Practitioners in Performing Joint Injection? Analysis of Training Courses and Literature Review

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Abstract

Introduction: While several studies have shown the usefulness and effectiveness of articular and abarticular corticosteroid injections performed by general practitioners, the main limitation that has been identified in expanding the use of these acts in everyday practice lies in a lack of training. Thus, this study aimed to determine the best settings for training courses concerning this subject. **Methods:** Our study was composed of two parts: the first one consisted in a survey concerning the improvements induced by training courses in the context of continuing medical education on the participants' skills and degree of confidence, the second part was a review of the published literature about this topic. **Results:** As expected, every training program analysed through our survey generated improvements in the participants' confidence in performing articular or abarticular injections. Furthermore, these findings are reflected in an increase in the proportion of such skills that the trainees complete by themselves. These results were reinforced by similar findings raised by the literature review. Moreover, it highlighted that hands-on training courses seemed to be the most efficient and that the use of synthetic models appeared to be a suitable alternative to human bodies or corpses, surrounded by less ethical and logistic concerns. **Conclusions:** This study supports the expansion of training courses for general practitioners on articular and abarticular injections. It also suggests that they should be based on a hands-on training design, possibly with the use of manikins.

Highlights

- The lack of training has been identified by general practitioners as the main limitation for expanding the use of articular injections in their everyday practice.
- Training courses have shown efficiency in inducing improvements regarding confidence and competence in performing such technical acts, with an impact on the clinical practice.
- Hands-on training appears to be the most suitable and efficient design for these programs.
- The use of synthetic models represents a reliable substitute for human bodies or corpses, avoiding significant logistic and ethical concerns.
- The findings of this manuscript support the development of training courses on articular injections, with the aim of improving patients' care.

Keywords: Injections; Intra articular; Education; Medical; Continuing; Review; State-of-the-art; Models; anatomic; General practice

Introduction

Nowadays, musculoskeletal diseases are one of the main reasons to seek a general practitioner's advice. Several previous studies [1-4] have demonstrated that corticosteroid injections are efficient in treating many conditions, such as tendinitis or aseptic arthritis for example. These injections can either be a first line

treatment, an alternative therapeutic tool or a complement to the pharmaceutical and educational treatments. Furthermore, these medical procedures are achievable in everyday clinical practice. As a matter of fact, studies about imaging guidance [5] have shown its usefulness to achieve a good needle placement but its involvement in improving the clinical results of the procedure still remains to be shown. Thus, in most cases, the use of ultrasound or another imaging guidance technique is not recommended as the first line approach, especially when the extra costs involved and the limited hypothetical clinical benefit are taken into account. As the contraindications to performing corticosteroid injections are not abundant and are easily identifiable [1], and as the significant complications are unusual (notably the infectious risk which remains lower than one case per twenty thousand procedures) [1,4,6,7], corticosteroid injections as part of primary care management seems to be practical. As it has already been demonstrated in other countries such as in United Kingdom for example [8,9], this management would allow a better use of health care services from the point of view of both patients and society. Thus, beyond the patient's satisfaction of being treated by his family physician [10], a significant clinical advantage has been found that lies in the achievement of a fast symptom relief (which is currently unfortunately difficult to obtain in regard of the current delays for access to specialist consultations). This is reinforced by the possibility of withdrawing earlier the other pain medications, thus limiting their adverse side effects, such as those of non-steroidal anti-inflammatory drugs for example [8,9,11,12]. It should be highlighted that, despite the increase in the proportion of medical technical acts provided by general practitioners, the studies related to this issue have not shown any deterioration in the quality of the patient care delivered, as documented for example in the field of dermatology by the rate of skin samples that had adequate margins regarding curative resection of malignant skin lesions performed by general practitioners [8,9,11]. At the medico-economic level, increasing access to corticosteroid injections in the context of primary care would permit a decrease in the costs to society related to iterative consultations and repeated treatments as well as a reduction of the cumulative duration of sick leaves [8,9,11-13]. Furthermore, this consolidation of the leading role of primary care practitioners would also allow an easier access to specialists for complex cases by avoiding an overload of their consultation slots due to situations that could have been handled by a general practitioner [8,9,11]. Despite all these advantages and the declared will of most of the interviewed general practitioners to perform this kind of procedures, corticosteroid injections remain uncommon in the field of primary care [14,15]. Previous works about this subject pointed out the lack of training to perform these acts [10,14-16]. In addition, these studies and doctoral theses highlighted the desire of general practitioners to be trained with the aim of subsequently modifying their practices [10,14,16,17]. This change in patient care has the primary purpose of allowing the family physician to reposition himself as a leading actor of the health care system. In this respect, interviewed patients massively answered in favour of a training of general practitioners in performing corticosteroid injections, showing moreover an assumed commitment in receiving an appropriate first line treatment [10]. As the current model of medical studies in France and student demography do not allow for sufficient training time for hands-on procedures at the bedside in specialized departments during the initial training, it seems appropriate to pursue training in the field of continuing medical education [18]. The objective of our study was to determine the best training approach to teach corticosteroid injections to general practitioners as well as setting up a training course on this matter. As it represents a broad topic and in order to enhance the probability of finding significant results and limiting potential bias, a decision was made to reduce the field of this study to articular or abarticular corticosteroid injections in the knee and the shoulder joints. This decision relies on the fact that these localisations are the most frequently involved in the execution of corticosteroid injections [6,14,15], as these are also feasible in the general practice setting on the basis of anatomic landmarked guidance determined by inspection and palpatory examination.

Methods

In order to determine the best training method, this study consisted at first in an analysis of the current courses including training on or exclusively about corticosteroid injections, ongoing in the field of continuing medical education. This evaluation was designed to be conducted through the dissemination of a survey to each general practitioner that either attended to a training session in 2017 or followed an online training course at any time during this same year in France. As it was clearly identified that the design of this survey (lying on voluntary answers) could be responsible of a risk of low response rates, as experienced in previous studies and doctoral theses, thus representing a potential significant selection bias, it was therefore decided that this first part of the study would be analysed in the light of a second part consisting in a literature review. This one was concerned with the efficiency of current training courses and teaching policies in other countries as well as with studies on new technical skills acquisition, such as those related to basic acts in the surgical practice. The main evaluation criterion was the efficiency of different training course models in terms of technical abilities of the trainees and benefits for patients as well as for the health care system.

Physicians' survey

In order to ensure the comparability of the different training courses, we took the decision to restrict the analyses to those certified by the French national agency of continuing medical education, because of their asserted quality due to the imposed requirements and specifications. Through a screening on the corresponding website (www.agencedpc.fr) of the former and currently available training courses regarding exclusively or partially corticosteroid injections in either the knee or the shoulder or both articulations, we thus identified 10 programs carried out by 8 training institutes. There were 9 on-site training courses, divided in 19 sessions, and 1 online training course by e-learning. The main characteristics of each training course are summarized in Table 1.

Title (translated from the original French version)	Predetermined modalities of the training course	Medical specialty of the course instructor	Number of sessions delivered in 2017	Maximal number of trainees in each session
Injections in the main articulations	On-site training consisting in workshops, exclusively about injections	General practitioner	2	30
Injections in general practice	On-site training combining theory lessons and workshops, exclusively about injections	General practitioner	1	35
Injections: indications, contraindications, methods	On-site training, exclusively about injections	General practitioner	6	40
Shoulder, wrist and hand diseases	On-site training, approaching injections while speaking about musculoskeletal illnesses	Sports physician and general practitioner	2	30
Twists and tendinitis in general practice: from references to practice	On-site training, approaching injections while speaking about musculoskeletal illnesses	Sports physician and general practitioner	2	30
Technical acts in rheumatology	On-site training consisting in workshops on synthetic joints models, exclusively about injections	General practitioner	3	40
Injections by the general practitioner	On-site training, exclusively about injections	General practitioner	1	20
Technical acts in primary care	On-site training, teaching injections among other medical technical acts	General practitioner	1	20
Non-traumatic diseases of the knee	On-site training combining theory lessons and workshops, approaching injections while speaking about the knee diseases	General practitioner	1	35
Injections in everyday practice	e-learning, exclusively about injections	General practitioner	Not applicable	

Table 1: General characteristics of the different training courses ongoing during 2017.

A survey (see translated version in Additional file 1), assessing demographic data and questions on perceived changes in skills by general practitioners that had taken part in one of these training courses and on the impact in modifying their practice, was addressed by electronic mail to each institute. Repeated phone reminders were also performed with the aim of obtaining a higher rate of answers. Statistical analyses were performed using Microsoft® Excel and the BiostaTGV online software. It consisted in a Student t-test or a linear regression as required depending on the type of data, the degree of statistical significance (α) was defined as 0.05.

The survey was addressed to physicians, it did not concern data about patients and it did not interfere with the patients' care, its purpose did not consist in the development of biological knowledge or medical guidelines. Indeed, in compliance with the decree 2017-884 of 9th May 2017, a need for consent was deemed unnecessary according to French regulations. This protocol has been approved by the ethics committee of Le Mans General Hospital.

Literature Review

Concerning the literature review, a global search was done inside the Medline database using keywords arranged in the following request: ((((“arthrocentesis”[MeSH Terms]) OR “biopsy, fine needle”[MeSH Terms]) OR “injections, intra articular”[MeSH Terms])) AND (((((((“education, medical”[MeSH Terms]) OR “education, medical, continuing”[MeSH Terms]) OR “learning curve”[MeSH Terms]) OR (“task performance and analysis”[MeSH Terms])) OR “teaching”[MeSH Terms]) OR “learning”[MeSH Terms]) OR “general practice”[MeSH Terms])

OR "rheumatology/education"[MeSH Terms]). Only articles written in French or English with an available abstract were retained in the initial selection. There was no other restriction, particularly no limitation in the date of publication as well as in the age of the involved subjects, veterinary studies were also considered. In order to complete this screening, it was there implemented by additional published studies, linked with the previous ones when identified as similar, if they were judged potentially relevant for the topic on the basis of their title. After removal of duplicates, a pool of 160 articles was left. Then 108 studies were excluded after reading the abstract because they did not evaluate training methods for teaching injections. Similarly, 33 other studies were excluded after reading the full text of the article for the same reason and 1 more as it was the preliminary study of another one included in the literature review. There were thus 18 remaining articles. The whole selection process is described in Figure 1.

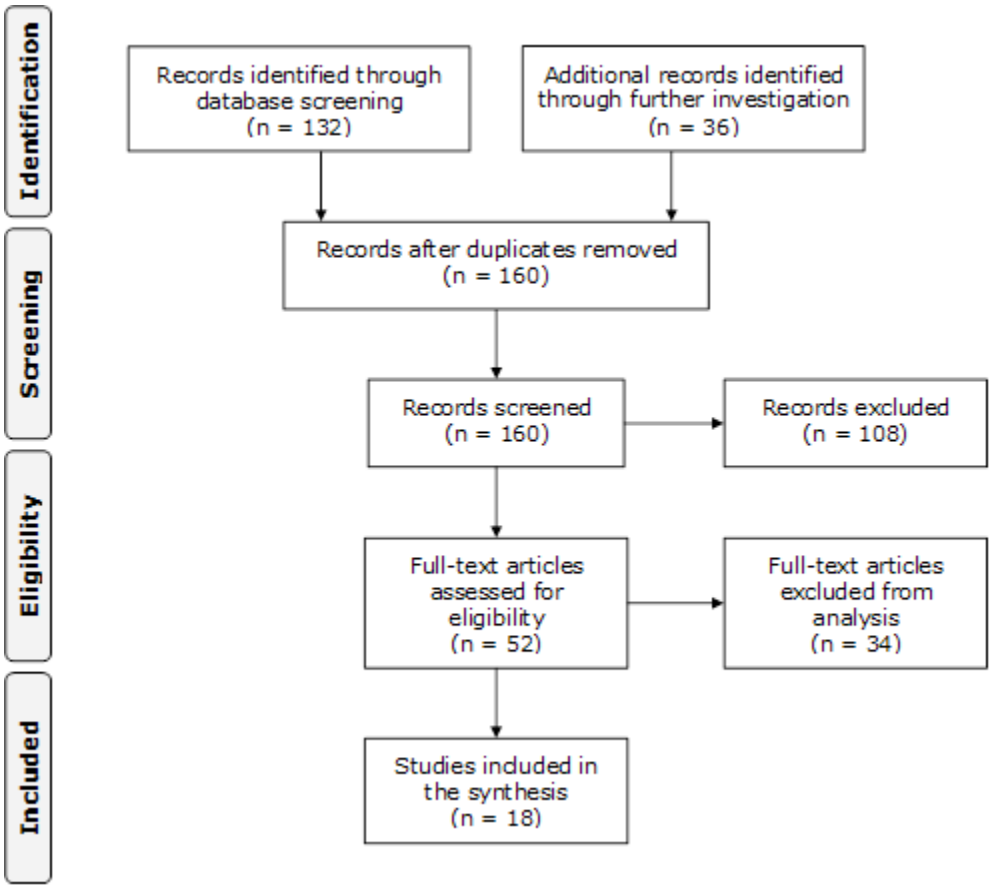

Figure 1: Flow diagram of the literature review [19].

The methodological quality of the included studies was appraised using either CONSORT, SQUIRE or STROBE checklists, as required according to the design of the study, and according to the publishing journal's last available Impact Factor. These considerations are represented in Figure 2.

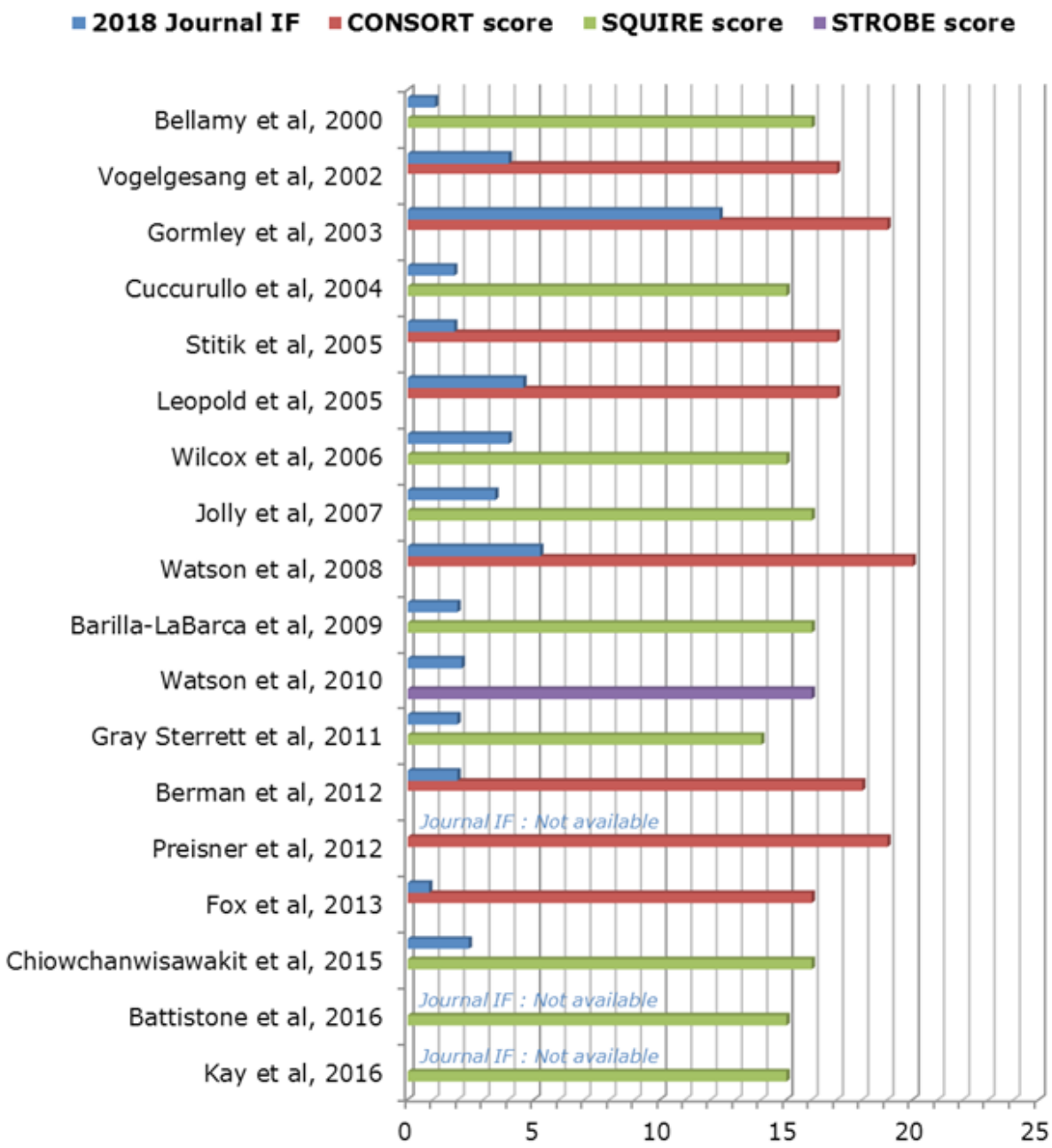

Figure 2: Assessment of the included studies methodological quality [20-37]

An exclusion of the studies with a poor methodological quality, arbitrarily predefined as a score lower than 60 percent in the appropriate score (meaning a score lower than 15 points out of 25 using the CONSORT checklist, 12 points out of 19 using the SQUIRE checklist or 14 out of 22 using the STROBE checklist), was intended but none met this criterion.

Results

Physicians' survey

We obtained a total amount of 56 answers to our survey, representing participants of 6 distinct training courses. The mean age of the responders was 42.8 years, ranging from 30 to 70. The mean post-graduate work experience was 13.2 years, with a minimum of 1 year and a maximum of 40. 28.6% of the responders were women (16 among 56). Regarding the referral habits of practitioners in the situations when they did not perform the injection by themselves, 83.9% (47) reported they preferred to address patients to a rheumatologist while 10.7% (6) referred them to a radiologist, 3.6% (2) to an orthopaedic surgeon and 1.8% (1) to a sports physician. The mean declared delay to obtain an appointment for the patient with the specialist was 4.6 weeks. Before they took part in a training course, the mean rate of corticosteroid injections performed by the general practitioners was of 31.6% in the knee and 27.9% in the shoulder among the whole indicated injections in these joints. Meanwhile, the mean self-evaluated degree of confidence in performing such technical acts was 3.34 on a Likert scale ranging from 0 (weak) to 10 (high confidence) for the shoulder injections and 4.34 for the knee injections. These results are summarized in Table 2.

	Mean value before the training course	Mean value after the training course	Mean difference	p
In the whole population of this study				
In the knee (n = 56)				
Self-assessed degree of confidence	4.34	6.07	+ 1.73	**0.007**
Proportion performed by themselves	3.16	4.59	+ 1.43	**0.040**
In the shoulder (n = 56)				
Self-assessed degree of confidence	3.34	5.48	+ 2.14	**0.0006**
Proportion performed by themselves	2.79	4.25	+ 1.46	**0.029**
For those that evaluated their level of confidence as null at baseline				
In the knee (n = 13)				
Self-assessed degree of confidence	0	1.92	+ 1.92	**0.030**
Proportion performed by themselves	0	0.92	+ 0.92	0.208
In the shoulder (n = 19)				
Self-assessed degree of confidence	0	1.42	+ 1.42	**0.001**
Proportion performed by themselves	0	2.58	+ 2.58	**0.032**
For those that declared they did no injection at baseline				
In the knee (n = 22)				
Self-assessed degree of confidence	1.45	3.59	+ 2.14	**0.017**
Proportion performed by themselves	0	1.73	+ 1.73	**0.028**
In the shoulder (n = 24)				
Self-assessed degree of confidence	0.50	3.29	+ 2.79	**0.0003**
Proportion performed by themselves	0	1.63	+ 1.63	**0.008**

Table 2: Summary of the received answers about the proportion of completion and the perceived confidence degree in performing joints injections.

As expected, the training courses showed a significant improvement in the confidence of the participants in performing joint injections in both the knee and the shoulder. Similarly, they also led to an increase in the rate of procedures performed by the general practitioners. Moreover, these positive findings were slightly better when we restricted the analyses to those that did no corticosteroids' injection at baseline. By contrast, our study has not been effective in finding any statistically significant association between personal

characteristics or concerning the design of the training course and the self-assessed improvement of the abilities in performing a joint injection. These results are reported in Table 3.

	Improvement in the self-assessed confidence		**Improvement in the proportion of completion**	
	Knee	**Shoulder**	**Knee**	**Shoulder**
Depending on personal characteristics				
Sex	p = 0.423	p = 0.873	p = 0.320	p = 0.373
Age	p = 0.080	p = 0.506	p = 0.528	p = 0.226
Post-graduate work experience	p = 0.110	p = 0.737	p = 0.394	p = 0.136
Delay to obtain an appointment with the specialist	p = 0.703	p = 0.340	p = 0.622	p = 0.596
Depending on training course design				
On-site training VS e-learning	p = 0.296	p = 0.950	p = 0.956	p = 0.712

Table 3: Analyses of the association between personal or training course characteristics and improvement in the perceived confidence level or rate of completion of joints injections.

Literature Review

In order to ensure a standardization of the analyses, based on the reported values in the manuscripts, calculations were made to determinate odds ratios regarding the variations of the judgement criteria in the trained subjects in comparison with the control group. These results are depicted as forest plot diagrams in Figure 3.

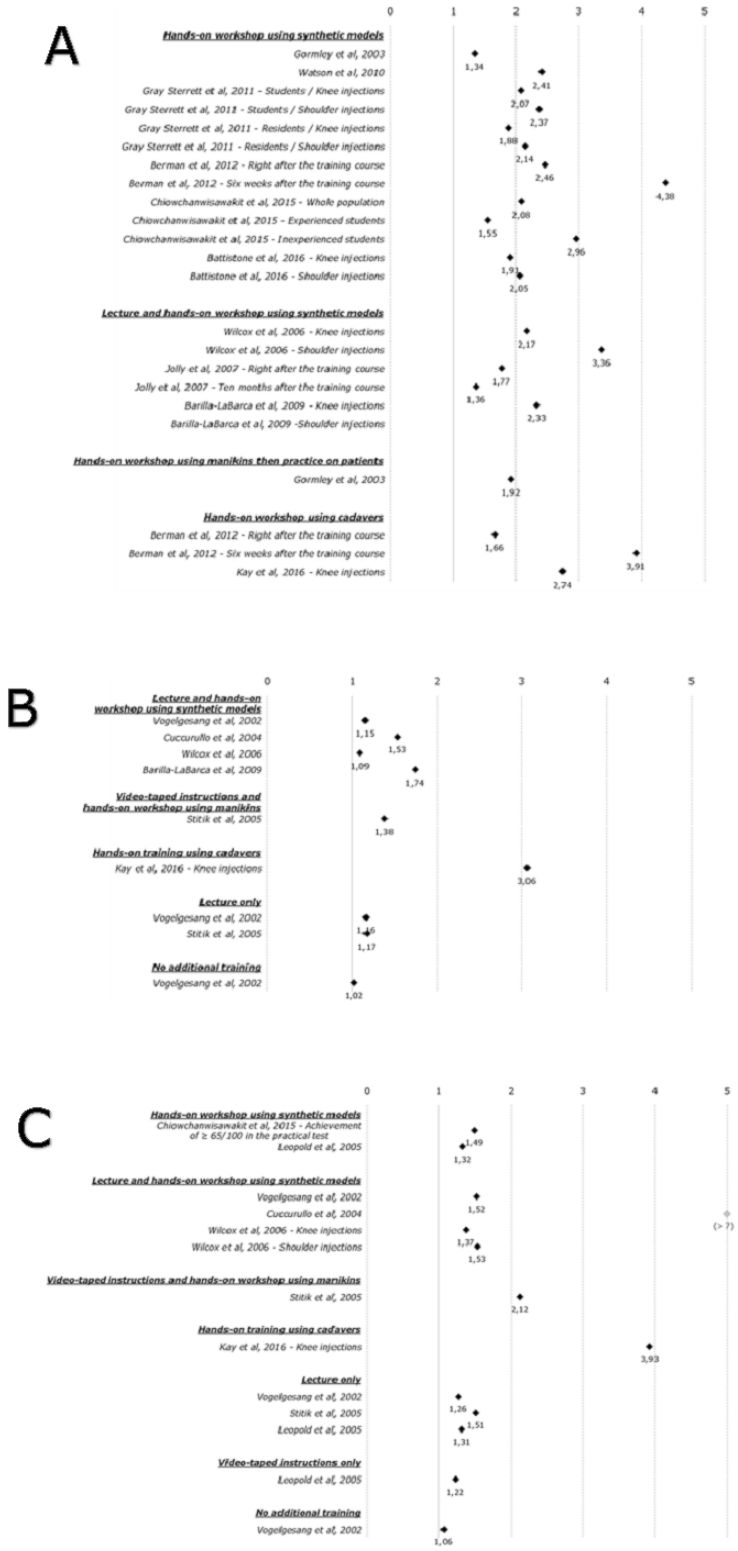

Figure 3: Induced variations in confidence (A), theoretical performance (B) and practical competencies (C) among participants of the analysed training courses [20-37].

As represented in the corresponding charts and as also expected, both confidence and skills in providing a joint injection were improved by each one of the training courses. Accordingly with this illustration, it appears that hands-on workshops seem to represent a more valuable training method than instructions, either by lecture or video-taped. Along these lines, the mean odds ratios were 1.17 concerning the improvement in the theoretical performance and 1.33 regarding the variations in the practical competencies for the training courses relying on instructions only while they were 1.66 and 2.54 for those including a hands-on workshop, but the observed differences were not statistically significant as the p-values were 0.16 and 0.13 respectively. Moreover, the efficiency of the training courses seems to be slightly better when they involved practice sessions on human bodies or corpses than those using synthetic models exclusively. Indeed, the mean odds ratio reporting the variation in the participants' confidence in performing joint injections was 2.56 for the training courses involving human bodies or cadavers while it was 2.42 for those using manikins. There was no statistically significant difference as the p-value was 0.81. Concerning the improvement in the performances, the calculations found odds ratios of 3.06 for theory and 3.93 for practice in training courses using cadavers or live bodies while they were 1.38 and 2.34 respectively in training courses using manikins, but the lack of data (with only one study [37] in which human corpses were used) prevented any statistical analyses of the observed difference.

Discussion

While the lack of skills in performing a joint injection has been identified by general practitioners as the main obstacle to its use in current practice, this article highlights the efficiency of training courses in improving both their confidence and their competencies. Thus, it can reasonably be expected that a development of such training programs would permit an increased use of these procedures in the primary care setting.

Along these lines, the results of our survey have shown that taking part in a currently ongoing continuing medical education training course is associated with both an improvement in the confidence in providing joint injections and an increase in the proportion of injections that are performed by general practitioners. Unfortunately, we had to deplore the unsatisfactory response rate to this survey, thus preventing us from finding any difference when considering the design of the training courses due to an obvious lack of power.

These results are consistent with previous studies about this topic. Indeed, for example, Leopold, et al. [25] have demonstrated that any training course, regardless of its design or its intensity, provides a positive impact in improving both the confidence and the performance of the participants in performing a simple task such as a knee injection. Similarly, these findings were also reported in other studies such as the one conducted by Vogelgesang, et al. [21]. Furthermore, while they have agreed with this conclusion, the authors have also highlighted the fact that a hands-on training course has shown better results than lecture only courses. In their article, Fox, et al. [34] have measured similar outcomes with significantly better post-training procedure achievement competencies for the students that had been trained on a cadaver or with the use of a manikin when compared with those having followed the textbook instructions. The authors thus concluded that a joint injection simulator appears to be an appropriate teaching aid to allow repeated training with the aim of acquiring the technical skills and confidence in the abilities in performing such procedures. This assertion substantiates the findings of Chen et al. [38] that have demonstrated the efficiency of simulation training in improving both the subjective comfort level and objective measurements of the skills required in performing injections among anaesthetic procedures. Meanwhile, the results from the studies carried out by Berman, et al. [32] and Gormley, et al. [22] suggest than practicing on a real body or human corpse provide slightly better learning curves than other designs of training courses, while the differences have not been found as statistically significant in the article by Fox, et al. [34] when comparing the cadaver group to the synthetic model one. Our literature review could not find statistically significant differences in this respect but the data was limited due to the lack of published studies in which real corpses were used.

Moreover, neither our survey nor the literature review has permitted to appraise correctly the place that should be assigned to the use of e-learning. According to Preisner, et al. [33] and Galland-Decker, et al. [39], the specificities of e-learning could contribute to a better retention of acquired competencies.

As it represents the most fundamental aim of such training courses, published studies have also demonstrated that these enhancements are reflected in everyday clinical practice with some implications on the patient's care. As an illustration, Bellamy, et al. [20] have shown statistically significant improvements in the patient's related outcomes after a viscosupplementation treatment if the general practitioner who performed this procedure had attended to a continuing medical education training course on this skill. Moreover, accordingly with the results reported by Vogelgesang, et al. [21], as they have observed a strong positive correlation between the trainee's level of confidence in providing a joint injection after the training course and his competencies in the realization of this task, it seems reasonable that physicians allow themselves to perform this skill as soon as they feel confident in achieving it. As a consequence, an increase in the number of the procedures realized by the participants after the training course has been highlighted in the study carried out by Gormley, et al. [22] as well as through the results of our survey.

This study has several strengths. First of all, its quality relies on the association of a systematic review of the literature and a survey which provides an update of the knowledge. The external validity has also been ensured by congruent results with former studies. Furthermore, the findings of this study fulfil a request coming from both the patients and the physicians, and these results reflect in concrete implications in everyday clinical practice.

It has also some limitations. One of them relies in a possible selection bias concerning our survey as we assume that less than

ten percent answered it. Unfortunately, the measure of this rate was impossible due to missing data. Thus, it is likely that the participants having taken part in our survey are also the most concerned and pleased with the training courses but we assume that, as these ones rely on an optional and voluntary participation, these trainees are also those being targeted by such training courses. However, the subsequent lack of power raised by the low number of responders could have prevented highlighting some differences depending on the design of these programs but the literature review has remedied this failure. Still, some points remain that require further investigations. Lastly, this study has also publication and retrieval bias, inherent to the design of any literature review.

Conclusions

Based on the conclusions of this thesis work, a training course has been implemented in the Le Mans General Hospital with the aim of teaching the knee and shoulder injections to interested general practitioners of the whole county. While the best educational results have been demonstrated using a human body or corpse, the current scientific evidence has shown that training using synthetic models is also a valid and efficient solution. Due to ethical considerations and logistic feasibility, the second option has been chosen for this training course. For each session, the size of the participants' group has been limited as it is suggested in recommendations [40]. A future study, currently ongoing, will evaluate the efficiency of this training course and its impact on the involved family physicians' practice.

Declarations

Ethics approval and consent to participate: The survey was addressed to physicians, it did not concern data about patients and it did not interfere with the patients' care, its purpose did not consist in the development of biological knowledge or medical guidelines. Indeed, in compliance with the decree 2017-884 of 9th May 2017, a need for consent was deemed unnecessary according to French regulations. This protocol has been approved by the ethics committee of Le Mans General Hospital.

Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request

Authors' contributions: AV conducted the survey and the literature review, analysed and interpreted the data. ED provided support as well as advices in conducting this study and also interpreted the data. Both authors were major contributors in writing the manuscript, read and approved the final manuscript.

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