Family Practice, 2021, 1–6
https://doi.org/10.1093/fampra/cmab116

OXFORD

Health Service Research

The use and safety of corticosteroid injections for shoulder pain in general practice: a retrospective cohort study

Pieter F van Doorn[a,*], Dieuwke Schiphof[a], Rianne M Rozendaal[a], Ramon P G Ottenheijm[b], Johan van der Lei[c], Patrick J E Bindels[a] and Evelien I T de Schepper[a]

[a]Department of General practice, Erasmus Medical Center, Rotterdam, The Netherlands, [b]Department of Family Medicine, CAPHRI Care and Public Health Research Institute, Maastricht, The Netherlands and [c]Department of Medical Informatics, Erasmus Medical Centre, Rotterdam, The Netherlands

*Correspondence to Department of General Practice, Erasmus Medical Center, PO Box 2040, 3000 CA, Rotterdam, The Netherlands; E-mail: p.vandoorn@erasmusmc.nl

Abstract

Background: Guidelines for shoulder pain in general practice recommend treatment with corticosteroid injections (CSI) if initial pain management fails. However, little is known about the actual use and safety of CSIs in treatment by general practitioners (GP).
Objective: The objective of this study was to gain insight into the use and safety of CSIs for patients with a new episode of shoulder pain in general practice.
Methods: A retrospective cohort study was conducted using a healthcare database containing the electronic medical records of approximately 200,000 patients in general practice. A search algorithm was constructed to identify patients with a new episode of shoulder pain between January 2012 and December 2017. Data on the use of CSIs in 2 random samples (n = 1,000) were manually validated for a 12-month period after the diagnosis.
Results: In total, 26% of the patients with a new episode of shoulder pain received a CSI. The patient's age (OR 1.03, 95% CI 1.02–1.04) and a history of shoulder pain (OR 1.52, 95% CI 1.13–2.12) were significantly associated with the administration of a CSI. Half of the patients received the CSI in the first consultation. The patient's age was positively associated with the likelihood of receiving the CSI in the first consultation (OR 1.01, 95% CI 1.00–1.02). No serious adverse reactions were recorded by the GP.
Conclusion: In contrast to the guidelines, CSIs were frequently administered in the first consultation. Older patients and patients with a history of shoulder pain were more likely to receive a CSI for shoulder pain.

Key words: corticosteroid injection, elderly, general practice, primary care, shoulder pain, side effects

Introduction

Guidelines on the management of shoulder pain in general practice recommend corticosteroid injections (CSIs) as a treatment option if a more conservative treatment has been applied initially and failed.[1–4] It is estimated that in about 20–24% of patients with shoulder pain, CSIs are given as a treatment by general practitioners (GPs)[5–7] and there are indications that CSI use in the management of shoulder pain is increasing. A recent study of management of rotator cuff

Key Messages

- One-quarter of the patients were treated with a corticosteroid injection (CSI).
- Half of the patients who received a CSI, got the CSI in the first consultation.
- Patients with a history of shoulder pain and elderly were more likely to get a CSI.

related shoulder pain by GPs in Australia reported a doubling in the use of CSIs by GPs, from 9.8% in 2000 to 19.7% in 2016.[7]

Although CSI use in the management of shoulder pain in general practice is increasing, the role of CSIs for the treatment of shoulder pain is still subject to debate. Systematic reviews of the effects of CSIs on shoulder pain only found evidence for a short-term (<12 weeks) positive effect on pain; no long-term effect was found.[8–20] Besides a lack of evidence for the long-term effectiveness, there are also safety concerns regarding the CSI. A recent systematic review of the impact of CSIs on rotator cuff health and repair reported that CSIs may have deleterious effects on rotator cuff healing and are associated with significant adverse events after a rotator cuff repair.[21] However, the reported frequency of serious adverse events in trials with CSI for tendinopathy is low: only one serious adverse event (tendon rupture) was found in 991 trial participants.[22]

This study aimed to gain insight into the use and safety of CSIs for shoulder pain in general practice using a retrospective cohort based on a GPs' database. The secondary aim of the study was to identify patient characteristics associated with the administration of a CSI, the administration of a CSI at the first consultation, and the administration of more than one CSI.

Methods

Design and setting

A retrospective cohort study was performed using the Rijnmond Primary Care database (RPCD). The RPCD is a region-specific derivative of the Integrated Primary Care Information (IPCI) database, under the supervision of the Department of General Practice of the Erasmus Medical Center. The medical records of patients in the database are pseudonymized and contain information on demographics, signs and symptoms, diagnoses (using the International Classification of Primary Care [ICPC] codes), clinical findings, laboratory test results, drug prescriptions, referrals to specialists, and hospitalization. In the Netherlands, each citizen is registered with a GP and they are fully insured for primary care without co-payment. The GP is the first point of care for complaints that require medical care. More details on the IPCI database have been published elsewhere.[23] The RPCD contained over 200,000 patient records from more than 100 GPs in the greater area of Rotterdam, the Netherlands, at the time of our study. This study was approved by the Governance Board of Rijnmond Primary Care (project number 19.03).

Study population

Our study population consisted of all adult patients (≥18 years) who had consulted their GP with a new episode of shoulder pain between 1 January 2012 and 31 December 2017. This population was selected by using the ICPC codes for shoulder pain, L08.00 (shoulder symptoms/complaints) or L92.00 (shoulder syndrome/PHS). An episode was considered new if the patient had not been diagnosed with one of these ICPC codes in the preceding 12 months. Consequently, a patient could be included more than once during the 5-year study period. All eligible patients had at least one year of valid data available after the initial diagnosis. To study our objectives, 2 patient samples were constructed (Fig. 1).

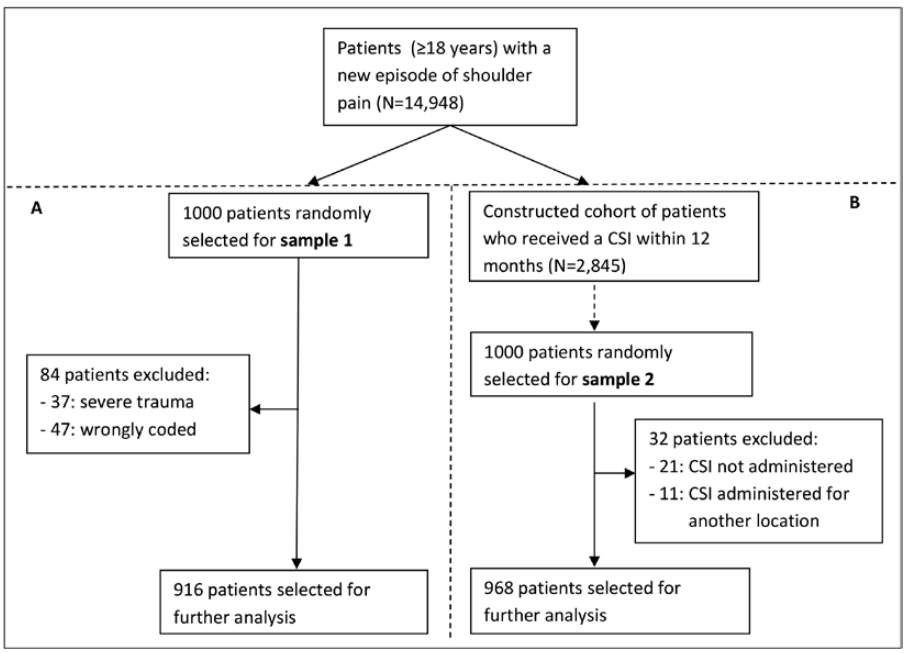

Fig. 1. Flow chart showing the patient sample selection. A) Selection of sample 1: Patients with a new episode of shoulder pain. B) Selection of sample 2: Patients with a new episode of shoulder pain who received a corticosteroid injection (CSI).

Sample 1: patients with a new episode of shoulder pain (*n* = 1,000)

From the total study population of patients with a new episode of shoulder pain (*n* = 14,948), 1,000 cases were randomly selected. All cases in this sample were screened manually, and cases were excluded that were wrongly coded with the ICPC code L92 or L08, based on the free-text written by the GP. In this sample, all consultations and treatments within 12 months after the initial shoulder diagnosis regarding the current shoulder pain episode were extracted. This sample was used to determine the incidence of a CSI and to determine which patient factors are associated with the administration of a CSI (Fig. 1A).

Sample 2: patients with a new episode of shoulder pain receiving a CSI within 12 months after initial diagnosis (*n* = 1,000)

This sample consisted of patients from the study population with a new episode of shoulder pain cases who received a CSI within 12 months after the initial diagnosis (*n* = 2,845). Patients were selected for this cohort using an extensive algorithm. The algorithm included all Anatomical Therapeutic Chemical (ATC) codes, all action codes, and all free text registered by the GP. The ATC codes included for a CSI were: H02AB08, H02AB06, H02AB04, H02BX01, and C01BB01. The action code, 13023, which is the code for the administration of a CSI, was also included in our algorithm. Finally, free text registered by the GP at each consultation was used to include cases with the keywords *'R/x st kena'*, which indicates the prescription of a CSI. A random sample of 1,000 cases was drawn from the constructed cohort for further analyses. All cases in this random sample were studied in detail, from the initial diagnosis until 12 months following the CSI. Cases were excluded if the CSI was not administered or was administered for a different complaint. This second sample was used to determine the frequency and timing of a CSI and any adverse reactions, and to determine which patient factors are associated with receiving the injection at the first consultation and receiving more than one injection (Fig. 1B).

Variables

Relevant patient characteristics were extracted from the full medical record files in both samples. These characteristics were age at first consultation, sex, history of shoulder complaints (an episode of shoulder complaints ≥12 months before the current episode), and the presence of the following comorbidities: diabetes (type 1 or 2), rheumatic disease (fibromyalgia, polymyalgia rheumatica, rheumatoid arthritis, or Bechterew's disease), and osteoarthritis (knee osteoarthritis, hip osteoarthritis, or peripheral osteoarthritis). Furthermore, all adverse reactions within 3 months after the initial CSI that were recorded in the free text by the GP were extracted from the medical file.

Statistical methods

Descriptive statistics were used to describe the patient characteristics, frequency, and timing of the CSI and adverse reactions. A multivariate logistic regression analysis of sample 1 was performed to predict the probability that a patient would receive a CSI in the 12 months following the initial diagnosis. For sample 2, a multivariate logistic regression analysis was performed to determine the likelihood of receiving more than one CSI and to determine the likelihood of receiving a CSI at the initial consultation. The following patient characteristics at the time of the initial diagnosis were used as predictor variables: age, sex, history of shoulder complaints, and the presence of comorbidities: diabetes, rheumatic disease, osteoarthritis. Interaction effects for all predictor variables were tested for significance. A *P*-value less than 0.05 was considered statistically significant. All calculations were performed using SPSS (version 25).

Results

Our search algorithm identified 18,678 adult patients with a new episode of shoulder pain in the Rijnmond Primary Care database (2012–2017). A total of 3,730 patients had to be excluded because they did not have 12 months of valid follow-up data available. This resulted in a total study population of 14,948 patients, of whom 56% were women; the mean age was 53.9 years (SD 16.2).

Sample 1: patients with a new episode of shoulder pain (*n* = 1,000)

In this sample of 1,000 patients with a new episode of shoulder pain, 84 patients had to be excluded because they did not meet the criteria for the definition of shoulder pain[1] (Fig. 1). Therefore, the positive predictive value (PPV) for the algorithm was 91.6%. Of the included patients (*n* = 916), 58% were female and the mean age was 53.8 years (SD 15.5). In total, 31% had a history of shoulder pain, 13% had a diagnosis of osteoarthritis, 10% had diabetes and only 2% had a diagnosis of a rheumatic disease. In this sample, 237 patients (26%) received a CSI administered by the GP within 12 months after the initial shoulder pain diagnosis (Table 1).

In the multivariate logistic regression analysis, the patient's age (OR 1.03, 95% CI 1.02–1.04) and history of shoulder complaints (OR 1.52, 95% CI 1.13–2.12) were positively associated with the likelihood of receiving a CSI within 12 months. Sex and the presence of a diabetes diagnosis were not associated with receiving a CSI (Supplementary Table 1).

Sample 2: patients with a new episode of shoulder pain receiving a CSI within 12 months after initial diagnosis (*n* = 1,000)

In the sample of 1,000 patients with a new episode of shoulder pain receiving a CSI within 12 months after initial diagnosis, 32 patients

Table 1. Characteristics of sample 1: patients with a new episode of shoulder pain and the incidence of the administration of a corticosteroid injection (CSI) within 12 months after the initial shoulder pain diagnosis (2012–2017).

Baseline characteristics	Full sample (n = 916)	No CSI (n = 679)	CSI (n = 237)
Sex			
Male	381 (42)	291 (43)	90 (38)
Female	535 (58)	388 (57)	147 (62)
Age (years)			
Mean (SD)	53.8 (15.5)	52.2 (15.7)	58.4 (13.8)
Medical history			
History of shoulder complaints[a]	285 (31)	193 (28)	92 (39)
Comorbidities			
Diabetes	93 (10)	69 (10)	24 (10)
Rheumatic diseases	22 (2)	12 (2)	10 (4)
Osteoarthritis	115 (13)	74 (11)	41 (17)

Data are presented in numbers (percentages) unless mentioned otherwise.

[a]A history of shoulder complaints was positive if the patient had an episode of shoulder complaints ≥12 months before the current episode.

had to be excluded, because the CSI was either not administered or was administered for a different, non-shoulder related, complaint (Fig. 1). Therefore, the PPV for this algorithm was 96.8%. In the final sample (n = 968), 60% were female and the mean age was 58.8 years (SD 13.7). A history of shoulder pain was seen in 37% of the patients, 16% had a diagnosis of osteoarthritis, 13% had diabetes, and only 3% had a diagnosis of a rheumatic disease.

In this sample, 486 patients (50%) received the CSI at the first consultation. In total, 333 patients (34%) received more than 1 CSI during 12 months of follow-up, 258 patients received 2 CSIs, and 75 patients received 3 or more CSIs, one of whom received 6 CSIs (Table 2).

In the multivariate logistic regression analysis, only the patient's age was positively associated with the likelihood of receiving the CSI at the first consultation (OR 1.01, 95% CI 1.00–1.02) (Supplementary Table 2) and with the likelihood of receiving more than 1 CSI (OR 1.01, 95% CI 1.00–1.02) (Supplementary Table 3).

In 43 patients (4%), adverse reactions were recorded by the GP within 3 months after the initial CSI administration. No serious adverse reactions were reported by the GP. The most common side effects were as follows: local skin reaction, hyperglycemia, and abnormal menstruation (Table 3).

Discussion

Key results

In this retrospective cohort study, we examined the use of CSIs by the GP in the treatment of shoulder pain. This study found that a quarter of patients with a new episode of shoulder pain received a CSI within 12 months after the initial diagnosis. Furthermore, we found that in half of the cases the GP administered the CSI as the initial treatment, which is not in accordance with the current guidelines.[1–4] Older patients were more likely to receive a CSI, to receive the CSI at the first consultation, and to receive multiple CSIs within 1 year after the initial diagnosis.

Strengths and limitations

A major strength of this study is that both samples (each with N = 1,000) were manually validated and screened, including the free-text written by the GP, from the initial diagnosis through 12 months of follow-up. This ensured that only valid cases were used in our analyses and all information on the use and safety of CSIs recorded by the GP was extracted. Furthermore, the positive predictive values of both the algorithms used to select our cases were high (91.6% and 96.8%, respectively).

However, the GP medical record is not primarily meant for data collection and has its limitations.[24] First, in this study we relied solely on the data recorded by the GP. For instance, the duration, cause, origin, and information on any previous non-GP treatments of shoulder pain (e.g. physiotherapy or over-the-counter medication) were often not reported in the medical files. It can be assumed that these factors do influence the choice of treatment by the GP, making the logistic regression models used in this study to predict the use of CSIs prone to potential residual confounding. Furthermore, specific information on the use of CSIs, such as dose, location of the injection, or the GP's rationale for the use of a CSI, was not available in the medical record. Secondly, for this study we were dependent on what the patient tells the GP and whether the patient consults the GP. For example, if a patient experienced a side effect of the CSI but did not consult the GP or did not mention it to the GP, it was not recorded in our study.

Although the use of medical records for data collection has its limitations, one strength of this study lies in its retrospective design. GPs could not have been influenced in their use of CSIs by this study design. Furthermore, in the Netherlands, all patients must be registered with a GP and the GP is the first point of care for complaints that require medical care. Therefore, our results can be considered to be a true representation of the actual use of CSIs as a treatment for shoulder pain in primary care.

Comparison with existing literature

Our study found that 26% of the patients with a new episode of shoulder pain received a CSI administered by the GP. This is in line with other studies, which observed percentages ranging from 20% to 24%.[5–7] The small difference could be explained by the difference in inclusion criteria. Our study only included patients with a new episode of shoulder pain, while other studies also included prevalent cases. Furthermore, our study included all patients with shoulder pain, irrespective of the origin, while other studies only included patients with rotator cuff-related pain.[7]

In 49.8% of the patients who received a CSI, the CSI was given in the first consultation. This is not in line with the recommendation in the guidelines, which states that the GP should start with advice, give information, and prescribe analgesics.[1–4] However, we found a

Table 2. Characteristics of sample 2: patients with a new episode of shoulder pain who received a corticosteroid injection (CSI) within 12 months after the initial shoulder pain diagnosis, and the frequency and timing of the corticosteroid injections (2012–2017).

Baseline characteristics	Full sample (n = 968)	Number of injections		Injection at first consultation	
		1	>1	No	Yes
Sex					
Male	384 (40)	262 (41)	122 (36)	177 (36)	207 (43)
Female	584 (60)	373 (59)	211 (63)	305 (63)	279 (57)
Age (years)					
Mean (SD)	58.8 (13.7)	57.8 (13.8)	60.7 (13.3)	57.5 (13.5)	60.1 (13.8)
History of shoulder complaints[a]	357 (37)	241 (38)	116 (35)	168 (35)	189 (39)
Comorbidities					
Diabetes	123 (13)	74 (12)	49 (15)	59 (12)	64 (13)
Rheumatic diseases	32 (3)	20 (4)	12 (3)	23 (4)	9 (3)
Osteoarthritis	159 (16)	91 (14)	68 (20)	75 (15)	84 (17)

Data are presented in numbers (percentages) unless mentioned otherwise.

[a]A history of shoulder complaints was positive if the patient had an episode of shoulder complaints ≥ 12 months before the current episode.

Table 3. Reported adverse reactions within 3 months after the CSI.

Adverse reaction	No.
Local skin reaction	14
Hyperglycaemia	9
Abnormal menstruation	6
Flushing	5
Arrhythmia	4
Increased pain	4
Headaches	3
Cramps	2
Vertigo	1
Nausea	1

N = 968. Forty-three patients (4%) had reported adverse reactions. In 4 patients, more than 1 adverse reaction was reported.

wide variety of patient and shoulder characteristics presented at the first consultation in general practice, which could explain why GPs decided to deviate from the guideline. Furthermore, as previously mentioned, we did not have any information on over-the-counter medication or other possible treatments before the first consultation with the GP. It could be that patients who had already had other treatments before the first consultation received a more intensive treatment by the GP at the first consultation.[5]

The patient's age and history of shoulder complaints were both positively associated with the administration of a CSI by the GP. This is in line with the findings of other studies. Feleus et al.[5] found that older patients (46–64 years) were more likely to receive a CSI compared to younger patients (18–45 years). A possible explanation for an increase in the likelihood of receiving a CSI with an increase in the patient's age could be because GPs are more reluctant to prescribe NSAIDs or opioids in the elderly population[25,26] or they expect better or similar results for younger patients with other, less invasive treatment options (e.g. physical therapy or NSAIDs).

In the 968 patients who received a CSI, no serious adverse reactions were recorded by the GP. Minor side effects that were reported include local skin reactions, hyperglycemia, and abnormal menstruation. These side effects are well known and have been described in previous studies on the adverse reactions of CSIs.[22,27,28] However, a more recent review points out the possible adverse impact of CSIs on rotator cuff tendon health.[29]

This review included in vitro and in vivo studies of tendon health after a CSI and showed that there are molecular and biomechanical changes, such as increased apoptosis, decreased cellular proliferation, and decreased maximal load to failure of the tendon. The authors concluded that practitioners should be aware of these deleterious effects. Although our study found no serious adverse reactions, we want to emphasize the need for this awareness among GPs administering CSIs in elderly patients, who presumably already demonstrate degenerative changes in the targeted tissue.

Conclusion

In conclusion, we found that CSIs were commonly applied by the GP in the treatment of shoulder pain and were often administered in the first consultation. Older patients were more likely to receive a CSI, receive a CSI in the first consultation, and receive more than 1 CSI. Although the rationale of the GP for the administration of a CSI were unknown, it is remarkable that the patient's age has a significant influence on the choice by the GP to administer a CSI. Further studies should be done in order to reveal the rationale by the GP for the administration of a CSI, while also taking the patient's individual preferences into account.

This explorative, descriptive study serves as a step towards determining the role of CSIs in the treatment of shoulder pain in general practice. However, high-quality evidence on the effectiveness of CSI for shoulder pain is still lacking, especially in the long term. Therefore, it is recommended that more high-quality trials examining the effectiveness of a CSI for shoulder pain should be performed in order to determine the role of CSIs in the treatment of shoulder pain in general practice.

Supplementary Material

Supplementary material is available at *Family Practice* online.

Ethical approval

This study was approved by the Governance Board of Rijnmond Primary Care (project number 19.03).

Funding

This study was part of a project funded by 'Stichting Fonds Alledaagse Ziekten' (reference number SFAZ 2018-02).

Conflict of interest

The authors declare no conflict of interest.

Data availability

Data not publically available.

References

1. Dutch College of General Practitioners. NHG Standaard Schouderklachten. https://richtlijnen.nhg.org/standaarden/schouderklachten (accessed March 2020).
2. Codsi M, Howe CR. Shoulder conditions: diagnosis and treatment guideline. *Phys Med Rehabil Clin N Am*. 2015:**26**(3):467–489.
3. Hopman K, Krahe L, Lukersmith S, McColl AR, Vine K. 2013. *Clinical Practice Guideline for the Management of Rotator Cuff Syndrome in the Workplace*. The University of New South Wales.
4. Kulkarni R, Gibson J, Brownson P *et al*. Subacromial shoulder pain. *Shoulder Elbow*. 2015:**7**(2):135–143. doi:10.1177/1758573215576456
5. Feleus A, Bierma-Zeinstra SM, Bernsen RM, Miedema HS, Verhaar JA, Koes BW. Management decisions in nontraumatic complaints of arm, neck, and shoulder in general practice. *Ann Fam Med*. 2009:**7**(5):446–454.
6. Kooijman M, Swinkels I, van Dijk C, de Bakker D, Veenhof C. Patients with shoulder syndromes in general and physiotherapy practice: an observational study. *BMC Musculoskelet Disord*. 2013:**14**:128.
7. Naunton J, Harrison C, Britt H, Haines T, Malliaras P. General practice management of rotator cuff related shoulder pain: A reliance on ultrasound and injection guided care. *PLoS One*. 2020:**15**(1):e0227688.
8. Buchbinder R, Green S, Youd JM. Corticosteroid injections for shoulder pain. *Cochrane Database Syst Rev*. 2003:**2003**(1):CD004016.
9. Artus M, van der Windt DA, Afolabi EK, Buchbinder R, Chesterton LS, Hall A, Roddy E, Foster NE. Management of shoulder pain by UK general practitioners (GPs): a national survey. *BMJ Open*. 2017:**7**(6):e015711.
10. Cook T, Minns Lowe C, Maybury M, Lewis JS. Are corticosteroid injections more beneficial than anaesthetic injections alone in the management of rotator cuff-related shoulder pain? A systematic review. *Br J Sports Med*. 2018:**52**(8):497–504.
11. Gaujoux-Viala C, Dougados M, Gossec L. Efficacy and safety of steroid injections for shoulder and elbow tendonitis: a meta-analysis of randomised controlled trials. *Ann Rheum Dis*. 2009:**68**(12):1843–1849.
12. Koh KH. Corticosteroid injection for adhesive capsulitis in primary care: a systematic review of randomised clinical trials. *Singapore Med J*. 2016:**7**(12):646–657.

13. Lin MT, Hsiao MY, Tu YK, Wang TG. Comparative efficacy of intra-articular steroid injection and distension in patients with frozen shoulder: a systematic review and network meta-analysis. *Arch Phys Med Rehabil*. 2018:**99**(7):1383–1394 e1386.
14. Mohamadi A, Chan JJ, Claessen FM, Ring D, Chen NC. Corticosteroid injections give small and transient pain relief in rotator cuff tendinosis: a meta-analysis. *Clin Orthop Relat Res*. 2017:**475**(1):232–243.
15. Shah N, Lewis M. Shoulder adhesive capsulitis: systematic review of randomised trials using multiple corticosteroid injections. *Br J Gen Pract*. 2007:**57**(541):662–667.
16. Song A, Higgins LD, Newman J, Jain NB. Glenohumeral corticosteroid injections in adhesive capsulitis: a systematic search and review. *PMR*. 2014:**6**(12):1143–1156.
17. Sun Y, Chen J, Li H, Jiang J, Chen S. Steroid injection and nonsteroidal anti-inflammatory agents for shoulder pain: a PRISMA systematic review and meta-analysis of randomized controlled trials. *Medicine (Baltimore)*. 2015:**94**(50):e2216.
18. Sun Y, Zhang P, Liu S, Li H, Jiang J, Chen S, Chen J. Intra-articular steroid injection for frozen shoulder: a systematic review and meta-analysis of randomized controlled trials with trial sequential analysis. *Am J Sports Med*. 2017:**45**(9):2171–2179.
19. Wang W, Shi M, Zhou C, Shi Z, Cai X, Lin T, Yan S. Effectiveness of corticosteroid injections in adhesive capsulitis of shoulder: a meta-analysis. *Medicine (Baltimore)*. 2017:**96**(28):e7529.
20. Zheng XQ, Li K, Wei YD, Tie HT, Yi XY, Huang W. Nonsteroidal anti-inflammatory drugs versus corticosteroid for treatment of shoulder pain: a systematic review and meta-analysis. *Arch Phys Med Rehabil*. 2014:**95**(10):1824–1831.
21. Puzzitiello RN, Patel BH, Nwachukwu BU, Allen AA, Forsythe B, Salzler MJ. Adverse impact of corticosteroid injection on rotator cuff tendon health and repair: a systematic review. *Arthroscopy*. 2020:**36**(5):1468–1475.
22. Coombes BK, Bisset L, Vicenzino B. Efficacy and safety of corticosteroid injections and other injections for management of tendinopathy: a systematic review of randomised controlled trials. *Lancet*. 2010:**376**(9754):1751–1767.
23. Vlug AE, van der Lei J, Mosseveld BM, van Wijk MA, van der Linden PD, Sturkenboom MC, van Bemmel JH. Postmarketing surveillance based on electronic patient records: the IPCI project. *Methods Inf Med*. 1999:**38**(4-5):339–344.
24. Verheij RA, Curcin V, Delaney BC, McGilchrist MM. Possible sources of bias in primary care electronic health record data use and reuse. *J Med Internet Res*. 2018:**20**(5):e185.
25. Mikelyte R, Abrahamson V, Hill E, Wilson PM. Factors influencing trends in opioid prescribing for older people: a scoping review. *Prim Health Care Res Dev*. 2020:**21**:e36.
26. McDonald J, McBain L, Dowell AC, Morris C. GPs' views and experiences of prescribing non-steroidal anti-inflammatory drugs: a qualitative study. *BJGP Open*. 2017:**1**(2):bjgpopen17X100869.
27. Brinks A, Koes BW, Volkers AC, Verhaar JA, Bierma-Zeinstra SM. Adverse effects of extra-articular corticosteroid injections: a systematic review. *BMC Musculoskelet Disord*. 2010:**11**:206.
28. Brook EM, Hu CH, Kingston KA, Matzkin EG. Corticosteroid injections: a review of sex-related side effects. *Orthopedics*. 2017:**40**(2):e211–e215.
29. Puzzitiello RN, Patel BH, Forlenza EM, Nwachukwu BU, Allen AA, Forsythe B, Salzler MJ. Adverse impact of corticosteroids on rotator cuff tendon health and repair: a systematic review of basic science studies. *Arthrosc Sports Med Rehabil*. 2020:**2**(2):e161–e169.