Radiofrequency denervation for sacroiliac and facet joint pain

Systematic Review

Ludwig Boltzmann Institut
Health Technology Assessment

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Commissioned by the Austrian Ministry of Health, this report systematically assessed the intervention described herein as decision support for the inclusion in the catalogue of benefits.

CONTENT INFORMATION

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Content

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List of abbreviations

AQoL..... Assessment of Quality of Life
(generic instrument to measure health related quality of life)
CE marking ..... Conformité Européene Mark
CRF..... conventional RFD
DRG..... Diagnosis Related Groups (diagnosebezogene Fallgruppen)
EQ-5D..... generic instrument to measure health related quality of life
FDA..... Food and Drug Administration
FJ..... facet joint
FJI ..... facet joint injection
GPE..... Global Perceived Effect
GRADE..... Grading of Recommendations Assessment, Development and Evaluation
HTA ..... Health Technology Assessment
LBI-HTA ..... Ludwig Boltzmann Institut for Health Technology Assessment
LBP ..... low back pain
MD ..... mean difference
NR..... not reported
NRS..... Numeric Rating Scale
n.s. ..... not significant
ODI ..... Oswestry Disability Index
PRF ..... pulsed RFD
pts..... patient(s)
RCT..... Randomised Controlled Trial
RF..... radiofrequency
RFD ..... radiofrequency denervation
SF-36..... generic instrument to measure health related quality of life
SI ..... sacroiliac
SIJ..... sacroiliac joint
s.s. ..... statistically significant
VAS ..... Visual Analogue Scale
VNS ..... Visual Numeric Pain Scale
vs..... versus
yrs..... years

Summary

Introduction

Health Problem

In the scope of this assessment, chronic low back pain deriving from the facet or sacroiliac joints is the condition of interest. Low back pain is defined as pain and discomfort, localised between the costal margin and above the inferior gluteal folds, with or without referred leg pain that persists for at least 12 weeks. The cause for sacroiliac pain is a sacroiliac joint dysfunction (due to hypermobility/instability or hypomobility/fixation).

chronische Rückenschmerzen können ihren Ausgang u. a. von Facetten- oder den Iliosakralgelenken nehmen

The lifetime prevalence of low back pain has been estimated up to 84%. Within 12 months, a quarter of the Austrian population is affected by chronic low back pain/problems (2014). Reliable epidemiological data on the proportion of facet or sacroiliac joint pain is missing.

Lebenszeitprävalenz von Rückenschmerzen bis zu 84 %

Description of Technology

Radiofrequency denervation (RFD) is a minimally invasive procedure. A radiofrequency generator produces an alternating electrical current through an insulated needle. At the tip of the needle, the electric field induces ionic movements in the tissue directly surrounding the tip. The heat from the tip of the device is used to produce a lesion in the nerves suspected of contributing to the pain.

Radiofrequenz-denervierung (RFD) ist minimal invasive Methode, die durch Wärmeentwicklung gezielt schmerzleitende Nerven zerstört

Research question

Is radiofrequency denervation of the facet joints or sacroiliac joint in comparison to placebo or other treatments in patients with chronic facet joint pain or sacroiliac joint pain with a positive response to diagnostic block more effective and safe concerning pain, functional status, global improvement, health-related quality of life, and complications?

Frage, ob RFD andere Interventionen überlegen

Methods

Domain effectiveness and safety

During the scoping process, we identified a recently published Cochrane Review dealing with radiofrequency denervation for chronic low back pain. The Cochrane review's literature search (from inception to May 2014) had been conducted in several databases. We decided to use the relevant parts of the Cochrane review (on facet and sacroiliac joint pain) as the primary source for this report and refrained from conducting a (redundant) systematic literature search by ourselves. To ensure completeness and up-to-dateness, we performed the following manual searches: contact with the Cochrane Review fist author, systematic search in Medline using the search strategy from the Cochrane review (complemented by the search term *sacroiliac joint*), hand-search in Pubmed, and contact of two manufacturers.

rezenter Cochrane Review identifiziert, ergänzt um: Kontaktaufnahme mit Cochrane Erstautor, (systematisches Update) Medline Suche ergänzt um den spezifischen Begriff der Iliosakralgelenke Gelenke, Handsuche in Pubmed

Results

Available evidence

15 RCTs

10 RCTs for facet joint pain and 2 RCTs for sacroiliac joint pain fulfilled the inclusion criteria for the effectiveness assessment. Further, 3 RCTs (comparing different RFD methods) were included for safety considerations.

für Facettengelenke: 6 Plazebo/4 Steroidinjektionstherapie kontrolliert; ~680 PatienInnen, max. Beobachtungsdauer 12 Monate, die Hälfte der Studien mit hohem Biasrisiko

6 of 10 facet joint pain RCTs were placebo controlled (Sham intervention), 4 used steroid injections as comparator. The studies were published between 1994 and 2014, and included 31-120 patients each (a total of 323 patients in the placebo-controlled and 356 in the steroid injection controlled trials). Inclusion criteria differed considerably between studies, e.g., patients had to suffer from back pain for more than 3 months up to at least 2 years prior to the intervention. The mean age of included patients ranged from 41 to 64 years. The percentage of female participants was more than 55% in all but one trial. Patient follow up ranged from 3 to 12 months. Loss to follow up ranged from 0% to 10%, 2 trials did not report drop-outs. Half of the trials have been judged to have a high risk of bias, e.g., due to unclear blinding, unclear or high number of drop-outs, or differing baseline characteristics.

für Iliosakralgelenke: 2 Plazebo kontrolliert; ~80 PatienInnen, max. Beobachtungsdauer 3 Monate, 1 Studie mit hohem/ 1 mit geringem Biasrisiko

Both RCTs evaluating radiofrequency denervation for sacroiliac joint pain were placebo controlled, published from 2008-2012 and included a total of 79 patients. Patients had to suffer from low back pain at least for 6 months. The mean age of patients was 52-64 years, 57-82% of the patients were female. Length of follow-up was up to 9 months, but patients of the control groups were given the opportunity to cross-over after 1-3 months. One RCT was judged to have a low risk of bias, whereas the second RCT might imply a high risk due to differing baseline characteristics.

Clinical effectiveness

Facettengelenks-RFD vs. Plazebo insgesamt geringe Evidenz (z. B. für kurzfristige Schmerzlinderung <1 Monat)

Overall, the strength of evidence for the effectiveness of radiofrequency denervation for **facet joint pain in comparison to placebo** (sham intervention) is **low**. RFD compared to placebo might reduce pain in the short term (≤1 month), but not in the intermediate term (>1 to 12 months); it might not increase functional status <6 months, but between 6 to 12 months; it might not improve quality of life at 3 months, but might lead to a global improvement in the intermediate term (>1 up to 6 months).

Facettengelenks-RFD vs. Steroidinjektion insgesamt (sehr) geringe Evidenz (z. B. für Schmerzlinderung bis zu 12 Monate)

Overall, the strength of evidence for the effectiveness of radiofrequency denervation for **facet joint pain in comparison to steroid injections** is **low to very low**. RFD compared to steroid injections might reduce pain up to 12 months post intervention; it might not improve the functional status in the intermediate term (≥6 to <12 months); it might not improve quality of life up to 12 months. For the outcome of global improvement, **no evidence** is available.

RFD im Bereich der Iliosakralgelenke vs. Plazebo insgesamt (sehr) geringe Evidenz (z. B. für Schmerzlinderung >1 bis ≤3 Monate)

Overall, the strength of evidence for the effectiveness of radiofrequency denervation for **sacroiliac joint pain in comparison to placebo** (sham intervention) is **low to very low**. RFD compared to placebo might not reduce pain or improve functional status in the short term (≤1 month), but thereafter up to 3 months; it might lead to a global improvement up to 3 months; it might not increase quality of life up to 1, but up to 3 months. **No evidence** is available for all critical outcomes in an observation period of >3 months.

Safety

There is **very low evidence** that

- facet-joint RFD compared to placebo might not increase complications.
- facet-joint RFD compared to steroid injections does not lead to complications/major adverse events, infections or motor or sensory deficits, but might cause superficial burns after the intervention and an initial increase in back pain.
- sacroiliac-joint RFD compared to placebo might not increase serious complications.
- in the comparison of different RFD techniques, no complications/major adverse events, but mild localised pain or neuropathy like pain, can be observed.

sehr geringe Evidenz für „keine schwerwiegenden Komplikationen"

Upcoming evidence

We identified 2 ongoing RCTs on lumbar facet joint pain comparing conventional and cooled RFD (NCT02478437) and RFD with 80 vs. 90°C (NCT-02148003), and 2 on sacroiliac joint pain that compare RFD vs. a sham intervention (NCT01726608) or two different RFD methods (NCT02382289).

3 von 4 laufenden RCTs vergleichen unterschiedliche RFD Methoden

Reimbursement

Currently, seven RF lesion probe devices (not 'back-pain specific') are approved by the Food and Drug Administration (FDA). The cooled RFD system, which had been used in sacroiliac joint RFD studies so far, received FDA clearance and CE Marking. In Austria, radiofrequency denervation of the facet and sacroiliac joints can be reimbursed via the Austrian DRG-system (Leistungsorientierte Krankenanstaltenfinanzierung/LKF) using the code AJ140 "percutaneous destruction of peripheral nerves".

diverse RFD Devices 'FDA approved' bzw. CE-zertifiziert

Abrechnung aktuell in Ö über Code AJ140

Discussion

Overall, the level of evidence for the estimated effects is very low to low. This conclusion is primarily based on the high risk of bias of the majority of included studies (especially the potential effects of non-blinding of patients on exclusively patient-reported outcomes) and the small sample sizes.

insgesamt basieren die Effektschätzer auf einem geringen Evidenzlevel (v. a. durch Biasrisiko und geringe Stichprobengröße)

For reliable statements on effectiveness, long-term data (based on e.g., registries) would be essential, to determine the mean period of the effect, which is assumed to be not permanent due to nerve recovery, as well as alternative (more invasive) therapies prevented (e.g, SI joint fusion).

Different RFD techniques were used in the included trials (cooled RFD for sacroiliac joint pain and conventional or pulsed RFD methods for facet joint pain). Due to the observed heterogeneity (temperature, duration) and the current research focus (comparison of different techniques), it seems that the optimal "dose" of RFD is still under examination. In addition, the patient population varied between studies (different levels of 'chronicity'), which could have had an impact on the study results.

Übertragbarkeit der Ergebnisse potenziell eingeschränkt durch Unterschiede in den verwendeten RFD Methoden und eingeschlossenen Pat.

Results from facet joint RFD studies cannot be adopted one-to-one to SI joint RFD. Differences between medial and lateral branch neurotomy result from differences in the sensory innervation. Variations in the sacroiliac joint innervation are addressed by a different RFD technique that aims at causing 'bigger' (and more) lesions than used in conventional facet joint RFD.

Ergebnisse der Facettengelenks-RFD nicht 1:1 auf Iliosakralgelenks-RFD übertragbar

Patients with joint pain due to acute trauma, fracture, malignancy, and inflammatory disease were excluded from this review. Therefore, no conclusions can be drawn on the effectiveness of RFD in these indications.

Identifizierte Evidenzlücken v. a. keine Langzeitergebnisse

Neither for RFD in facet joints nor for RFD in sacroiliac joints (SI) are the long-term data (>12 months) available. Due to crossover, the situation is worst for RFD in SI joints, for which no group comparisons >3 months exist.

Limitations of our work comprise the bare confidence that the Cochrane Review's authors have not missed relevant trials, our safety assessment is only based on RCTs and some of the meta-analyses are insufficiently sound due to study dependencies or small number of studies.

Conclusion

derzeit keine Empfehlung zur Aufnahme in den Leistungskatalog

The current evidence is not sufficient to prove that the assessed technology radiofrequency denervation [in adult patients with chronic (>3 months, facet joint- or sacroiliac joint) low back pain who had a positive response to diagnostic block] is more effective than, and as safe as, the comparator(s) (placebo/sham intervention or conventional treatment). New study results will influence the estimated effect considerably. The re-evaluation is recommended in 2019.

Zusammenfassung

Einleitung

Indikation und therapeutisches Ziel

chronische Rückenschmerzen können ihren Ausgang u. a. von Facetten- oder den Iliosakralgelenken nehmen

Im Fokus dieses Berichts stehen PatientInnen mit chronischen Rückenschmerzen, die von den Facettengelenken oder den Iliosakralgelenken ausgehen. (Chronische) Schmerzen im Bereich des „unteren Rückens“ (Lumbalgien) sind Schmerzen zwischen Rippenbogen und Gesäßfalten, die in das entsprechende Bein ausstrahlen können, und für mindestens 12 Wochen bestehen. Schmerzen aus dem Bereich der Iliosakralgelenke sind durch eine Gelenksfunktionsstörung bedingt (Hypermobilität/Instabilität bzw. Hypomobilität/Fixierung).

Lebenszeitprävalenz von Rückenschmerzen bis zu 84 %

Die Lebenszeitprävalenz von Rückenschmerzen beträgt bis zu 84 %. Innerhalb von 12 Monaten gibt ein Viertel der Österreichischen Bevölkerung an, von chronischen Rückenschmerzen/-problemen betroffen gewesen zu sein (2014). Verlässliche epidemiologische Daten zum Anteil von Facetten- bzw. Iliosakralgelenksschmerzen fehlen.

Beschreibung der Technologie

Radiofrequenzdenervierung (RFD) ist minimal invasive Methode, die durch Wärmeentwicklung gezielt schmerzleitende Nerven zerstört

Radiofrequenzdenervierung (RFD) ist eine minimal invasive Behandlungsmethode. Ein Radiofrequenzgenerator erzeugt Wechselstrom. Das elektrische Feld induziert an der Spitze einer isolierten Nadel Ionenbewegungen im umgebenden Gewebe. Diese Wärme wird verwendet, um eine Läsion (Verletzung) jenes Nervens hervorzurufen, welcher als Verursacher der Schmerzweiterleitung vermutet wird.

Forschungsfrage

Frage, ob RFD andere Interventionen überlegen

Ist die Radiofrequenzdenervierung im Bereich der Facetten- bzw. Iliosakralgelenke im Vergleich zu Plazebo(Schein-)interventionen oder anderen Behandlungsmethoden bei PatientInnen mit chronischen Facetten- oder Iliosakralgelenksschmerzen (mit positivem Ansprechen auf eine diagnostische Nervenblockade) im Hinblick auf Schmerzen, Funktionalität, Allgemeine Verbesserung, gesundheitsbezogene Lebensqualität und Komplikationen wirksamer und sicherer?

Methoden

Klinische Wirksamkeit und Sicherheit

rezenter Cochrane Review identifiziert, ergänzt um: Kontaktaufnahme mit Cochrane Erstautor, (systematisches Update) Medline Suche ergänzt um den spezifischen Begriff der Iliosakralgelenke Gelenke, Handsuche in PubMed

Während des Scopingprozesses identifizierten wir einen rezenten Cochrane Review zur Radiofrequenzdenervierung bei chronischen Rückenschmerzen. Die systematische Literatursuche war in mehrere Literaturdatenbaken (bis Mai 2014) durchgeführt worden. Wir entschieden, die relevanten Berichtsteile dieser Übersichtsarbeit (zu Facetten- und Iliosakralgelenken) als Grundlage für den vorliegenden Bericht zu verwenden und verzichteten auf eine eigene (redundante) systematische Literatursuche. Um die Vollständigkeit und Aktualität zu gewährleisten führten wir zusätzlich folgende Handsuchen durch: Kontaktaufnahme mit dem Erstautor des Cochrane Reviews, systematische Suche in Medline unter Verwendung der Suchstrategie des Cochrane Reviews (ergänzt um den Suchbegriff ‚sacroiliac joint’), manuelle Suche in PubMed und Kontaktierung zweier Hersteller.

Ergebnisse

Verfügbare Evidenz

15 RCTs

10 randomisiert kontrollierte Studien (RCTs) zu Facettengelenksschmerzen und 2 RCTs zu Iliosakralgelenksschmerzen erfüllten die Einschlusskriterien für die Wirksamkeitsanalyse. Weitere 3 RCTS (Vergleiche unterschiedlicher RFD Methoden) wurden für die Sicherheitsbeurteilung eingeschlossen.

für Facettengelenke: 6 Plazebo-/4 Steroidinjektionstherapie kontrolliert; ~680 PatienInnen, max. Beobachtungsdauer 12 Monate, die Hälfte der Studien mit hohem Biasrisiko

6 der 10 Facettengelenksschmerz-RCTs waren Plazebo-kontrolliert (Scheinintervention), 4 verwendeten Steroidinjektionen als Kontrollintervention. Die Studien wurden zwischen 1994 und 2014 publiziert und inkludierten jeweils 31-120 PatientInnen (gesamt 323 Patientinnen in den Plazebo-kontrollierten und 356 in den Steroidinjektions-kontrollierten Studien). Die Einschlusskriterien unterschieden sich beträchtlich zwischen den Studien: PatientInnen mussten beispielsweise mehr als 3 Monate bis zu mindestens 2 Jahre an Rückenschmerzen leiden. Das mittlere Alter eingeschlossener PatientInnen reichte von 41 bis 64 Jahren. Der Anteil weiblicher StudienteilnehmerInnen betrug mit Ausnahme einer Studie mehr als 55 %. Die Nachbeobachtungszeit reichte von 3 bis 12 Monaten, zu 0-10 % der PatientInnen lagen zu diesem Zeitpunkt keine Daten vor (2 Studien machten keine Angaben hierzu). Die Hälfte der Studien weist ein Hohes Biasrisiko auf, beispielsweise aufgrund unklarer Verblindung, unklarer oder hoher Anzahl an Drop-outs oder Gruppenunterschieden in den Basischarakteristika.

für Iliosakralgelenke: 2 Plazebo kontrolliert; ~80 PatienInnen, max. Beobachtungsdauer 3 Monate, 1 Studie mit hohem/ 1 mit geringem Biasrisiko

Die beiden RCTs zu RFD bei Iliosakralgelenksschmerzen waren Plazebo-kontrolliert, wurden 2008-2012 publiziert und schlossen insgesamt 79 PatientInnen ein. PatientInnen mussten zuvor mindestens 6 Monate an Rückenschmerzen gelitten haben. Das mittlere Alter der PatientInnen war 52-64 Jahre, 57-82 % der PatientInnen waren weiblich. Die Nachbeobachtungsdauer betrug 9 Monate, allerdings hatten die PatientInnen der Kontrollgruppe nach 1-3 Monaten die Möglichkeit, in die Interventionsgruppe zu wechseln. Ein RCT wies ein geringes, das zweite ein hohes Biasrisiko (aufgrund von Gruppenunterschieden in den Basischarakteristika) auf.

Klinische Wirksamkeit

Facettengelenks-RFD vs. Plazebo insgesamt geringe Evidenz (z. B. für kurzfristige Schmerzlinderung <1 Monat)

Insgesamt ist die **Stärke der Evidenz für die Wirksamkeit der RFD bei Facettengelenksschmerzen im Vergleich zu einer Plazebointervention gering**. Die RFD könnte im Plazebovergleich zu einer kurzfristigen (≤1 Monat), nicht jedoch mittelfristigen (>1 bis 12 Monate) Schmerzreduktion führen, die Funktionalität nicht im Zeitraum < 6 Monaten, jedoch zwischen 6 und 12 Monaten verbessern, keinen Einfluss auf die gesundheitsbezogene Lebensqualität nach 3 Monaten haben, aber zu einer mittelfristigen (>1 bis zu 6 Monate) allgemeinen Verbesserung führen.

Facettengelenks-RFD vs. Steroidinjektion insgesamt (sehr) geringe Evidenz (z. B. für Schmerzlinderung bis zu 12 Monate)

Insgesamt ist die **Stärke der Evidenz für die Wirksamkeit der RFD bei Facettengelenksschmerzen im Vergleich zur Steroidinjektion gering bis sehr gering.** Die RFD könnte im Steroidinjektionsvergleich zu einer Schmerzreduktion bis zu 12 Monate postinterventionell führen, die Funktionalität mittelfristig (≥6 bis <12 Monate), und die gesundheitsbezogene Lebensqualität im Beobachtungszeitraum von 12 Monaten jedoch nicht verbessern. Für Auswirkungen auf die allgemeine Verbesserung ist keine Evidenz verfügbar.

Insgesamt ist die **Stärke der Evidenz für die Wirksamkeit der RFD bei Iliosakralgelenksschmerzen im Vergleich zu einer Plazebointervention gering bis sehr gering**. Die RFD konnte kurzfristig (≤1 Monat) Schmerzen nicht reduzieren sowie die Funktionalität oder Lebensqualität nicht verbessern (jedoch >1 bis zu 3 Monate) und führte zu einer allgemeinen Verbesserung bis zu 3 Monate. Für den Beobachtungszeitraum >3 Monate fehlt jegliche Evidenz zu den o.g. Ergebnisparametern.

RFD im Bereich der Iliosakralgelenke vs. Plazebo insgesamt (sehr) geringe Evidenz (z. B. für Schmerzlinderung >1 bis <=3 Monate)

Sicherheit

Es ist sehr geringe Evidenz verfügbar, dass

- die **RFD im Bereich der Facettengelenke im Plazebovergleich** nicht mit mehr Komplikationen assoziiert ist.
- die **RFD im Bereich der Facettengelenke im Vergleich mit Steroidinjektionen** nicht zu mehr Komplikationen/schwerwiegenden unerwünschten Ereignissen, Infektionen oder motorischen bzw. sensorischen Defiziten führt, aber zu oberflächlichem Brennen nach er Intervention sowie initialer Verschlechterung der Rückenschmerzsymptomatik.
- die **RFD im Bereich der Iliosakralgelenke im Plazebovergleich** nicht zu mehr schwerwiegenden Komplikationen führt
- im **Vergleich verschiedener RFD Techniken** keine Komplikationen/ schwerwiegende unerwünschte Ereignisse beobachtet wurden, jedoch geringfügige lokalisierte bzw. Neuropathie-ähnliche Schmerzen.

sehr geringe Evidenz für „keine schwerwiegenden Komplikationen"

Laufende Studien

Wir identifizierten 2 laufende RCTs, welche unterschiedliche RFD Techniken (NCT02478437: konventionelle vs. ‚cooled' RFD; NCT02148003: RFD mit 80 vs. 90°C) bei lumbalen Facettengelenksschmerzen vergleichen sowie 2 RCTs zu RFD bei Schmerzen im Bereich der Iliosakralgelenke (NCT01726608: RFD vs. Plazebo; NCT02382289: Vergleich zweier RFD Techniken).

3 von 4 laufenden RCTs vergleichen unterschiedliche RFD Methoden

Kostenerstattung

Derzeit sind sieben RFD Systeme (nicht Rückenschmerz-spezifisch) von der US Amerikanischen Food and Drug Administration (FDA) zugelassen. Das 'cooled RFD-'System, welches in den Studien zu den Iliosakralschmerzen verwendet wurde, besitzt sowohl eine FDA Zulassung als auch eine CE Zertifizierung. In Österreich kann die RFD der Facetten- oder Iliosakralgelenke derzeit über den (unspezifischen) Code AJ140 („perkutane Destruktion peripherer Nerven") des Leistungskatalogs für die leistungsorientierte Krankenanstaltenfinanzierung abgerechnet werden.

diverse RFD Devices 'FDA approved' bzw. CE-zertifiziert

Abrechnung aktuell in Ö über Code AJ140

Diskussion

Insgesamt basieren die Effektschätzer auf einem geringen bis sehr geringen Evidenzlevel. Diese Schlussfolgerung basiert primär auf dem hohen Biasrisiko des Großteils der inkludierten Studien (v. a. die potenziellen Auswirkungen der nicht-Verblindung von PatientInnen auf ausschließlich Patientinnenberichtete Ergebnisparameter) und die geringen Stichprobenumfänge.

insgesamt basieren die Effektschätzer auf einem geringen Evidenzlevel (v. a. durch Biasrisiko und geringe Stichprobengröße)

Für belastbare Aussagen zur Wirksamkeit wären Langzeitdaten (z. B. auf Registern basierend) erforderlich, um die mittlere Wirkungsdauer zu bestim-

men, welche aufgrund der Nervenregeneration als nicht permanent angenommen wird, sowie um bestimmen zu können, ob/welche alternativen (invasiveren) Behandlungen verhindert werden können (z. B. die Fusion des Iliosakralgelenks).

Übertragbarkeit der Ergebnisse potenziell eingeschränkt durch Unterschiede in den verwendeten RFD Methoden und eingeschlossenen Pat.

In den eingeschlossenen Studien wurden unterschiedliche RFD Techniken ('cooled' RFD für Iliosakralgelenksschmerzen und konventionelle oder gepulste RFD Methoden für Facettengelenksschmerzen). Aufgrund der beobachteten Heterogenität (Temperatur, Dauer) und dem aktuellen Forschungsfokus (Vergleich unterschiedlicher RFD Techniken) scheint die ‚optimale Dosis' der RFD nach wie vor beforscht zu werden. Darüber hinaus unterschied sich die PatientInnenpopulation zwischen den Studien (Unterschiedliches Ausmaß der Chronizität der Schmerzen), was einen Einfluss auf die Studienergebnisse haben könnte.

Ergebnisse der Facettengelenks-RFD nicht 1:1 auf Iliosakralgelenks-RFD übertragbar

Die Ergebnisse der Facettengelenks-RFD können nicht eins zu eins auf die Anwendung der RFD bei Iliosakralgelenksschmerzen übertragen werden. Die Unterschiede zwischen der medialen und lateralen Neurotomie basieren auf Unterschieden in der Gelenks-Innervation. Die anatomischen Variationen im Bereich der Iliosakralgelenke werden durch eine spezielle RFD Technik adressiert, welche darauf abzielt größere (und auch mehr) Läsionen hervorzurufen als die konventionelle Technik.

PatientInnen mit Gelenksschmerzen aufgrund von Traumata, Frakturen, malignen oder entzündlichen Erkrankungen wurden von diesem Bericht ausgeschlossen. Daher können keine Aussagen zur Wirksamkeit der RFD bei diesen PatientInnenpopulationen getroffen werden.

Identifizierte Evidenzlücken v. a. keine Langzeitergebnisse

Weder für die RFD im Bereich der Facettengelenke, noch für jene im Bereich der Iliosakralgelenke sind Langzeitdaten (>12 Monate) verfügbar. Aufgrund des Cross-overs (der Möglichkeit aus der Plazebo- in die Interventionsgruppe zu wechseln) ist die Situation am schlechtesten für die RFD im Bereich der Iliosakralgelenke, für welche keine Gruppenvergleiche (RFD vs. Plazebo) nach mehr als 3 Monaten vorliegen.

Als Limitationen unserer Arbeite können folgende Faktoren betrachtet werden: unser Vertrauen, dass die AutorInnen des Cochrane Reviews keine relevanten Studien übersehen hatten, die Basierung unserer Sicherheitsanalyse ausschließlich auf RCTs und die teilweise beschränkte Aussagekraft der Metaanalysen (aufgrund von geringer Studienanzahl bzw. voneinander abhängigen Studienergebnissen).

Empfehlung

derzeit keine Empfehlung zur Aufnahme in den Leistungskatalog

Die aktuelle Evidenz ist nicht ausreichend zu belegen, dass die untersuchte Technologie Radiofrequenzdenervierung [bei erwachsenen PatientInnen mit chronischen (>3 Monate, Facetten- oder Iliosakralgelenks-)Rückenschmerzen, die auf eine diagnostische Nervenblockade angesprochen hatten] wirksamer und vergleichbar sicher als/wie die Kontrollintervention(en) (Plazebo/Scheinintervention oder konservative Behandlung) ist. Neue Studienergebnisse werden den geschätzten Effekt maßgeblich beeinflussen. Eine Reevaluierung ist 2019 empfohlen.

1 Scope

1.1 PICO question

PIKO-Frage

Is radiofrequency denervation of the facet joints or sacroiliac joint in comparison to placebo or other treatments in patients with chronic facet joint pain or sacroiliac joint pain with a positive response to diagnostic block more effective and safe concerning pain, functional status, global improvement, health-related quality of life, and complications?

1.2 Inclusion criteria

Einschlusskriterien für relevante Studien

Inclusion criteria for relevant studies are summarized in Table 1-1.

Table 1-1: Inclusion criteria

Population	second-line treatment in adult patients with chronic (>3 months) low back pain (facet joint pain or sacroiliac joint pain) who had a positive response to diagnostic block ICD-10 code: M54.5 low back pain MeSH-terms: low back pain, zygapophyseal joint, sacroiliac joint Patients with acute trauma, fracture, malignancy and inflammatory disease were excluded.
Intervention	radiofrequency (RF) denervation (synonyms: radiofrequency neurotomy, radiofrequency ablation) No limits on the temperature were applied. Both continuous and pulsed RF were included.
Control	placebo other treatments*
Outcomes	
Efficacy	❖ pain ❖ functional status ❖ global improvement ❖ health-related quality of life ❖ ability to work ❖ satisfaction with treatment
Safety	❖ complications
Study design	randomised controlled trials

* *In deviation from the Cochrane review, studies comparing different methods of RFD were included for safety analysis only (not for efficacy).*

2 Methods

2.1 Research questions

Description of the technology	
Element ID	**Research question**
B0001	What is radiofrequency denervation?
B0002	What is the claimed benefit of radiofrequency denervation in relation to the comparators?
B0004	Who administers radiofrequency denervation and in what context and level of care is it provided?
B0008	What kind of special premises are needed to use radiofrequency denervation?
B0009	What supplies are needed to use radiofrequency denervation?
A0020	For which indications has radiofrequency denervation received marketing authorisation or CE marking?
A0021	What is the reimbursement status of radiofrequency denervation?

Health problem and Current Use	
Element ID	**Research question**
A0001	For which health conditions and for what purposes is radiofrequency ablation/denervation used?
A0002	What is the disease or health condition in the scope of this assessment?
A0003	What are the known risk factors for chronic low back pain?
A0004	What is the natural course of the disease or health condition?
A0005	What is the burden of disease for patients with chronic low back pain?
A0006	What are the consequences of chronic low back pain for the society?
A0024	How is chronic low back pain currently diagnosed according to published guidelines and in practice?
A0025	How is chronic low back pain currently managed according to published guidelines and in practice?
A0007	What is the target population in this assessment?
A0023	How many people belong to the target population?
A0011	How much is radiofrequency denervation of the facet and sacroiliac joints utilised?

Clinical Effectiveness	
Element ID	**Research question**
D0001	What is the expected beneficial effect of radiofrequency denervation on mortality?
D0005	How does radiofrequency denervation affect symptoms and findings (severity, frequency) of chronic low back pain?
D0006	How does radiofrequency denervation affect progression (or recurrence) of chronic low back pain?
D0016	How does the use of radiofrequency denervation affect activities of daily living?
D0012	What is the effect of radiofrequency denervation on generic health-related quality of life?
D0013	What is the effect of radiofrequency denervation on disease-specific quality of life?
D0017	Was the use of radiofrequency denervation worthwhile?

Safety	
Element ID	**Research question**
C0008	How safe is the technology in comparison to the comparator(s)?
C0002	Are there harms related to dosage or frequency of applying the technology?
C0004	How does the frequency or severity of harms change over time or in different settings?
C0005	What are the susceptible patient groups that are more likely to be harmed through the use of the technology?
C0007	Are the technology and the comparator(s) associated with user-dependent harms?

2.2 Sources

Description of the technology and Health Problem and current use

Informationen aus Handsuche und Einreicherangaben für Beschreibung des Gesundheitsproblems und der Technologie

- Publications identified by hand search
- Questionnaire completed by the submitting hospital

2.3 Systematic literature search

vorab Identifikation eines rezenten Cochrane Reviews

During the scoping process we identified a recently published Cochrane Review [1] dealing with radiofrequency denervation for chronic low back pain. This Cochrane review had a broader scope than our assessment (including not only pain from facet joints' and sacroiliac joints, but also from intervertebral discs and the dorsal root ganglion). The Cochrane review's literature search (from inception to May 2014) had been conducted in the following databases:

- Cochrane Central Register of Controlled Trials (CENTRAL)
- MEDLINE
- MEDLINE In-Process & Other Non-Indexed Citations
- EMBASE
- Cumulative Index to Nursing and Allied Health Literature (CINAHL)
- PsycINFO
- ClinicalTrials.gov
- World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP)

The complete search strategies can be found in the Appendix of the Cochrane review [1]. Additionally, the review authors mentioned an update of the literature search in June 2015.

Verzicht auf eigene systematische Literatursuche

Therefore, we decided to use the relevant parts of the Cochrane review (dealing with the facet and sacroiliac joints) as primary source for this report and we refrained from conducting a (redundant) systematic literature search by ourselves.

2.3.1 Additional searches

dennoch ergänzt um:

In a first step, we contacted the first author of the Cochrane review via e-mail. She informed us that one additional relevant study [2] had been identified by the update search of 2015 and not yet been incorporated in the review.

Kontaktaufnahme mit Cochrane Erstautorin

Additionally, on December 9th 2015, we conducted a (systematic) search in Medline and Pubmed using the search strategy from the Cochrane review (complemented by the search term *sacroiliac joint*) without date restrictions. This search yielded 9 additional references. None met the inclusion criteria.

systematisches Update der Medline Suche ergänzt um den spezifischen Begriff der Iliosakralgelenke

A hand-search in PubMed identified one article [3], which presented 12-month follow-up data of a trial [4] already included in the Cochrane Review. However, the results were not relevant for this review because the patients of the control group were unblinded after 3 months and had the opportunity to "cross-over" (i.e., almost all of the control patients also received the intervention). The 3-month follow-up data had already been presented in the included article (Patel et al. 2012 [4]).

Handsuche in Medline

Manufacturers of two products for sacroiliac joint pain radiofrequency denervation (Halyard Health and Baylis Medical) were contacted on the 21st of December, 2015. However, they didn't respond to our e-mail.

und Kontaktaufnahme mit 2 Herstellern

2.4 Flow chart of study selection

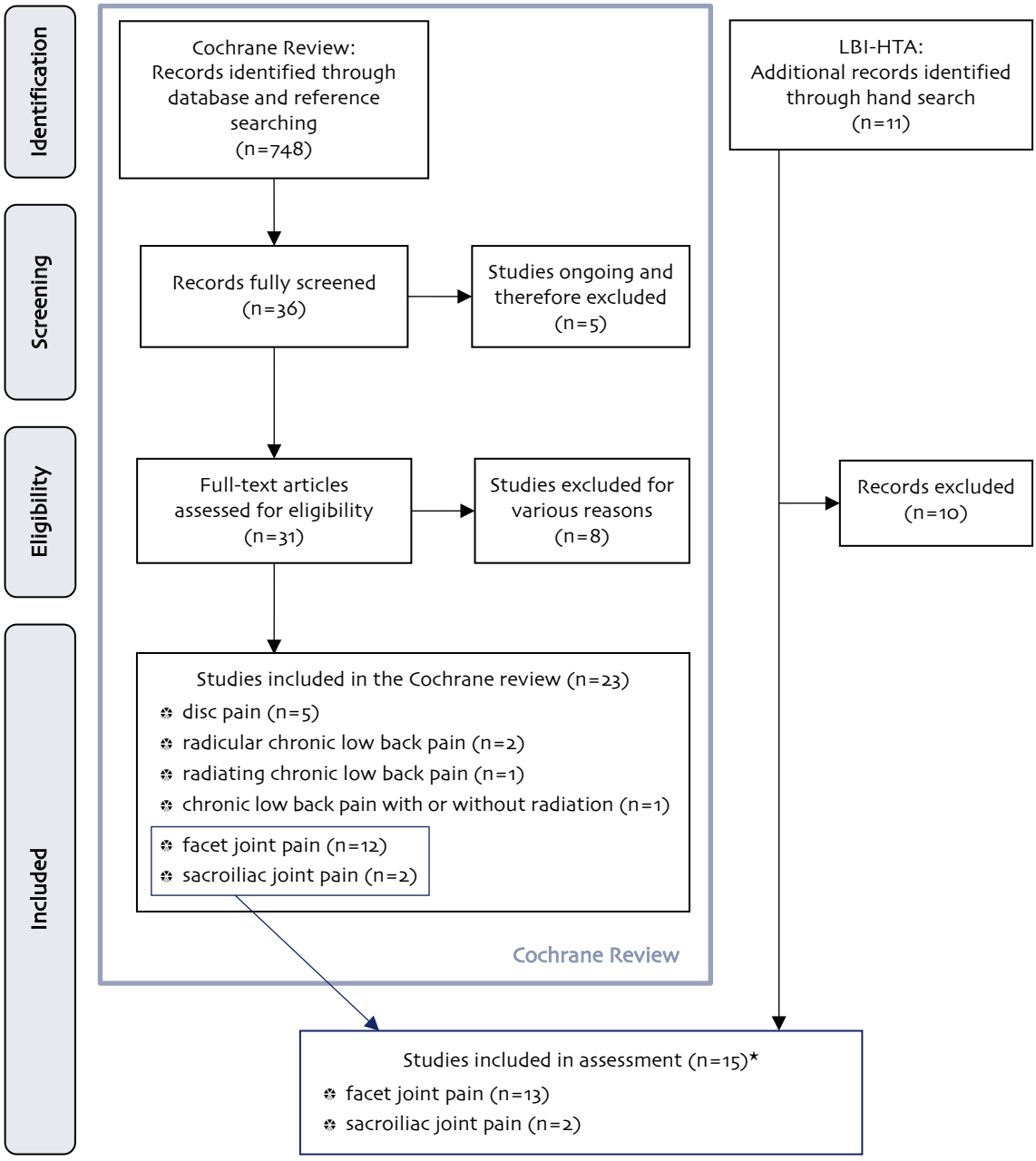
Literaturauswahl

The Cochrane review identified a total of 748 records through database and reference searching. 36 records were screened in full text and 23 studies fulfilled the inclusion criteria of the Cochrane review. Of these, 12 RCTs for facet joint pain and 2 RCTs for sacroiliac joint pain were relevant for our assessment.

im CR ursprünglich 12 RCTs für Facetten- und 2 für Iliosakralgelenke

Through our additional search (see 2.3.1.), we identified further 11 references of which 1 additional RCT fulfilled the inclusion criteria. The selection process is displayed in Figure 2-1.

ergänzt um ein weiteres RCT aus Handsuche



** for effectiveness: n=12 (facet joint pain: 10; sacroiliac joint pain:2); for safety: additional 3 RCTs for facet joint pain*

Figure 2-1: Flow chart of study selection (PRISMA Flow Diagram)

2.5 Analysis

Daten des Cochrane Review auf Basis der Primärstudien auf Korrektheit und Vollständigkeit überprüft, extrahiert und ggfs. ergänzt

As the scope of the Cochrane review [1] was broader than our research question, this report only focuses on its facet and the sacroiliac joint results. We checked the data extraction tables of the Cochrane review for accuracy and completeness (based on the included primary studies), adapted them to our format, extracted them, and added further relevant information from the primary studies. Data extraction was performed by one author (IR) and controlled by another author (KR).

Biasrisiko der Primärstudien mit dem Cochrane RoB Tool beurteilt

We assessed the quality of included primary studies using the Cochrane Risk of Bias Tool (see Table A-5).

2.6 Synthesis

Meta-Analysen für Schmerz und Funktionalität extrahiert bzw. durchgeführt

For the crucial outcomes pain (VAS) and functional status (ODI), we aimed at providing pooled data for effectiveness. We were able to extract some of the Cochrane Review's meta-analyses to our evidence profiles ('GRADE tables') and added own calculations if necessary. For these, we used the R package "meta"[1]. Because of heterogeneity, we chose a random effects model for all of our calculations. The only exception was the meta-analysis for the ODI score at 12 months (RFD vs. placebo), which only included 2 results from 1 study [5]. These were highly similar and the results remained exactly the same, regardless of whether the random or fixed effects model was used (p. 43). Meta-analyses are provided as mean differences (MDs) with 95% confidence intervals (95% CIs). When necessary, VAS/NRS scores were converted to scales ranging from 0 to 10. The Cochrane Review's authors solved the problem of missing standard deviations (SDs) by calculating them using reported values of the CI (and, if CIs were not available, they used SDs of baseline scores, or estimations of SDs based on other studies with the same population, treatment and score). We decided, in one case of missing SDs, for the post-interventional observation data [6] to use the baseline SD (and to additionally provide the effect estimates with halved and doubled SD; see footnote p. 43).

The questions were answered in plain text format with reference to the evidence profiles (see Table 7-1 to Table 7-5).

[1] Guido Schwarzer (2015). meta: General Package for Meta-Analysis. R package version 4.3-2., available at http://CRAN.R-project.org/package=meta

3 Description and technical characteristics of technology

Features of the technology and comparators

B0001 – What is radiofrequency denervation?

The use of radiofrequency denervation (RFD) for the treatment of back pain was first described in the literature in 1975 [7]. Radiofrequency denervation is a minimally invasive procedure that is usually performed with local anaesthetic and mild sedation. During this outpatient procedure, the patient is positioned face down and the skin is anaesthetized with a local anesthetic such as lidocaine [8]. Before the RFD procedure is done, a (lateral branch or medial branch) nerve block is performed in order to verify that the pain is being transmitted by those nerves [9].

RFD ist minimal-invasive Intervention, die unter Lokalanästhesie durchgeführt wird

RFD is done with the following elements: a radiofrequency generator, cannulas with active tips, and a thermocoupler that serves to sense the body temperature and transmit the radiofrequency energy [7].

es bedarf unterschiedlicher Komponenten

A radiofrequency generator produces an alternating electrical current with a frequency of 250 to 500 kHz through an insulated needle. At the tip of the needle, the electric field induces ionic movements in the tissue directly surrounding the tip. The heat from the tip of the device is used to produce a small lesion in the nerves suspected of contributing to the pain. The heat causes ionic agitation and friction, resulting in protein denaturating, cellular membrane disruptions, increased membrane permeability, and finally, tissue necrosis or lysis. The technique aims to interrupt the pain signals to the brain in order to eliminate the pain [1, 7, 10].

Generator produziert Wechselstrom, welcher Gewebe in Nadelspitzenumgebung erwärmt und damit den Nerv gezielt schädigt

RFD procedures can be classified in low-intensity RFD (which is administered constantly for 60-90 seconds at a specific temperature), cooled RFD (which involves the use of a cannula needle that has saline running through it to cool the tip), and pulsed RFD (which is done with signal interruption every half second, creating temperatures of 42° C) [7].

unterschiedliche RFD Techniken verfügbar

Comparators include therapeutic intra-articular (steroid) injections or sham RFD. In the sham surgery, a radiofrequency needle is inserted to the same location as in RFD, but the electric current is not turned on [8].

Vergleiche der RFD mit Steroidinjektionen oder Scheinoperation

Synonyms for radiofrequency denervation are the terms radiofrequency ablation and radiofrequency neurotomy.

Synonyme auch RF-Ablation oder Neurotomie

B0002 – What is the claimed benefit of radiofrequency denervation in relation to the comparators?

When the joint is determined to be the source of pain, as indicated by a positive diagnostic nerve block, prolonged pain relief may be achieved by RFD with destruction of the nerves to the affected joint. The procedure does not cure the source of pain, but instead destroys the pain signal to the brain by damaging the nerve, which can result in pain relief lasting from 6 months to, occasionally, greater than 12 months [8]. After this period of time, however, the nerve will regenerate and the pain may return [9].

RFD behebt nicht Schmerzursache, sondern soll Schmerzweiterleitung unterbrechen; Effekt durch Nervenregeneration temporär

According to the information provided by the submitting hospital, radiofrequency denervation of the sacroiliac joints may maintain the mobility of the sacroiliac joint, in comparison to the alternative of sacroiliac joint fusion.

RFD könnte ev. erforderliche therapeutische Fusion des SI Gelenks verhindern

Administration, Investments, personnel and tools required to use the technology and the comparator(s)

B0004 – Who administers radiofrequency denervation and in what context and level of care is it provided?

B0008 – What kind of special premises are needed to use radiofrequency denervation?

B0009 – What supplies are needed to use radiofrequency denervation?

laut Einreichern erforderlich:

According to the information received by the submitting hospital, the intervention is performed in specialised centres.

- spezialisiertes Zentrum
- erfahrenes OP-Team
- intraoperatives Röntgen

The intervention is performed by an experienced operation team, including an experienced orthopaedist, an assistant physician, a nurse, an anaesthetist (in the case of sedoanalgesia), and a radiological assistant for intraoperative X-ray monitoring.

An operating room with intraoperative X-ray monitoring is needed for the intervention.

Regulatory & reimbursement status

A0020 – For which indications has radiofrequency denervation received marketing authorisation or CE marking?

FDA reguliert RFD Produkte (nicht spezifisch für die Indikation)

RFD for back pain is a procedure and is therefore not subject to regulation by the Food and Drug Administration (FDA). However, the FDA regulates RFD devices and hence, there are various devices listed in the FDA 510(k) Premarket Notification database. The following generators received FDA clearance within the past 5 years:

- Erase Pen and Erase Tip System for Nerve Ablation, Models HC-0O01 and CS-0001 (Cheng Medical Corp.; approved 2011),
- NT 2000 Lesioning Generator (Neurotherm Inc.; approved 2011),
- Diros OWL™ URF-3AP(ML) (Diros Technology Inc.; approved 2010),
- Cosman G4 Radiofrequency Generator (Cosman Medical Inc.; approved 2008) [11].

aktuell 7 Systeme von der FDA zugelassen

There are currently seven RF lesion probe devices approved by the FDA:

- Baylis Pain Management Probe (Baylis Medical Co., Ontario, Canada; approved 2000),
- Baylis Pain Management Cooled Probe (Baylis Medical Co., Ontario, Canada; approved 2005; see also below),
- Baylis Pain Management Single-Use Probe (Baylis Medical Co., Ontario, Canada; approved 2007),
- Pajunk RFTL Radiofrequency Needle (Pajunk GmbH Medizintechnologie, Geisingen, Germany; approved 2006),
- Smith & Nephew RF Denervation Probes & RF Cannulae (Smith & Nephew Inc., Andover, MA, USA; approved 2004),
- Stryker RF Electrodes and Cannulae (Stryker Instruments Kalamazoo, MI, USA; approved 2004),
- Radionics disposable RF Cannulae (Technomed Europe, The Netherlands; approved 2004) [8].

The cooled RFD system Sinergy by Baylis Medical Co. Inc, used in the RFD studies for sacroiliac joint pain, was acquired by the Kimberly-Clark Corp. in 2009. SInergy comprises a pump, generator, and probe. The pump circulates sterile water through the probes. The various Baylis Pain Management probes are sterile, single-use devices that deliver RF energy while being cooled. The probes are used in conjunction with an RF generator to create RF lesions in nerves. All components have received FDA clearance as substantially equivalent to an approved predicate device.

das SInergy System (dzt. in Verwendung für SI RFD) 'ist zugelassen von der FDA und CE zertifiziert

The SInergy Pain Management System has also received CE Marking [12]. We were not able to identify a comprehensive list of other currently CE marked RFD systems and we refrained from a manual search for the CE marking of various RFD components.

A0021 – What is the reimbursement status of radiofrequency denervation?

Currently, radiofrequency denervation of the facet and sacroiliac joints can be reimbursed via the Austrian DRG-system (Leistungsorientierte Krankenanstaltenfinanzierung/LKF) using the code AJ140 "percutaneous destruction of peripheral nerves".

RFD kann derzeit über Code AJ140 abgerechnet werden

4 Health Problem and Current Use

Overview of the disease or health condition

A0001 – For which health conditions and for what purposes is radiofrequency ablation/denervation used?

Radiofrequency ablation is one of several types of ablation therapy. Therefore, it can be used to treat a wide range of conditions. For example, RFA is sometimes used in oncology [13] to treat (bone, kidney, liver, lung or prostate) cancers or precancerous lesions in the esophagus (Barrett's esophagus), in cardiology [14] to treat arrhythmias (e.g., supraventricular tachyarrhythmias), or in dermatology [15] to treat skin lesions. Finally, RFA is used in pain therapy, e.g., for the treatment of neck or low back pain (LBP).

RFD ist eine von zahlreichen Ablationstherapien, welche auch in anderen Indikationsbereichen eingesetzt wird

A0002 – What is the disease or health condition in the scope of this assessment?

In the scope of this assessment, chronic low back pain deriving from the facet or sacroiliac joints is the condition of interest. Low back pain is defined as pain and discomfort, localised between the costal margin and above the inferior gluteal folds, with or without referred leg pain, that persists for at least 12 weeks (European Guidelines from 2004 [16]). The cause for sacroiliac pain is a sacroiliac joint dysfunction (due to hypermobility/instability or hypomobility/fixation).

chronischer Rückenschmerz kann durch Veränderungen im Bereich der Facetten- oder Iliosakralgelenke bedingt sein

A0003 – What are the known risk factors for chronic low back pain?

There are many possible causes for low back pain, e.g., infections, tumours, osteoporosis, fractures, or spinal disc herniation. The majority of patients (approximately 85%) seen in the primary care, however, have non-specific low back pain, which is not attributable to a recognisable, known specific pathology or anatomical structure (e.g., infection, tumour, osteoporosis, fracture) [1, 17]. Suspected sources of back pain include lumbar facet (zygapophyseal) joints, sacroiliac joints, and degenerated intervertebral discs [1].

zahlreiche Schmerzursachen, in der Mehrzahl der PatientInnen jedoch unspezifisch/nicht eindeutig einer Ursache zuordenbar

Risk factors associated with back pain include smoking, obesity, age, female gender, physically strenuous work, sedentary work, psychologically strenuous work, low educational attainment, job dissatisfaction, and psychologic factors such as somatization disorder, anxiety, and depression [17].

Risikofaktoren für Rückenschmerzen u. a. Übergewicht, sitzende Tätigkeit, Stress etc.

A0004 – What is the natural course of chronic low back pain?

Chronic low back pain is seen as recurring or persistent condition showing a fluctuating course over time. It is likely that patients who report LBP will continue to report LBP in the future [18]. After an initial episode of low back pain, 44-78% of the patients suffer relapses of pain [16].

Rückenschmerzen zeigen rezidivierenden oder persistierenden Verlauf

Effects of the disease or health condition on the individual and society

A0005 – What is the burden of disease for patients with chronic low back pain?

PatientInnen weisen meist Komorbiditäten auf

Chronic low back pain is one of the most commonly reported pain conditions. It is often characterized by a long duration of illness and multiple recurrent episodes of pain. Patients with low back pain often report comorbidities such as osteoarthritis, cardiovascular and cerebrovascular diseases, as well as mental disorders, such as depression, anxiety disorders, and post-traumatic stress disorder. International data also show a positive correlation between low back pain and symptoms, such as migraine and headache, exhaustion, and respiratory symptoms [19].

A0006 – What are the consequences of chronic low back pain for the society?

Rückenschmerzen sind eine der teuersten Erkrankungen in Industrieländern (v. a. durch Arbeitsunfähigkeit/ Frühpensionierung)

Low back pain is one of the most expensive diseases in industrialised countries. It is one of the most frequent causes for inability to work and early retirement. In Germany, low back pain is estimated to cause direct costs of € 8.4 billion per year. According to international estimates, 85% of these costs are due to productivity losses because of inability to work and the remaining 15% are spent for medical treatment [19]. In the United States, costs of low back pain have been estimated to be more than 100 billion USD per year, primarily due to lost productivity [10].

Current clinical management of the disease or health condition

A0024 – How is chronic low back pain currently diagnosed according to published guidelines and in practice?

die Diagnose chronischer Rückenschmerz erfolgt auf Basis der Anamnese

Chronic low back pain is diagnosed by a detailed medical history (anamnesis). The medical history should include asking for onset of symptoms, duration, localisation and causes of pain, correlation of pain with specific positions and movements, earlier pain episodes, problems in activities of daily living, as well as psychosocial risk factors. An important part of the medical history is asking for red flag symptoms, which can indicate specific causes (e.g., fracture, tumour, infection, radiculopathy/neuropathy) with potentially urgent need for action [19, 20].

potentielle spezifische Ursachen sollen durch klinische Untersuchung und Bildgebung abgeklärt werden

An additional physical examination (e.g., inspection, palpation, test of the mobility of the lumbar spine, examination of the sacroiliac joint [19, 20]) aims at distinguishing between non-specific vs. specific (physical or mental) causes (as the above mentioned red flag symptoms do). Medical imaging also aims at identifying specific causes for low back pain. However, study results question its use as single diagnostic modality, because degenerative changes (here: ostoartritis of facet joints detected by CT) are common in the general population and increasing with age [21]. A large population based study failed to find an association of this CT-verified presence of degenerative osteoarthritis and low back pain [21].

During the care process, the assessment of psychosocial and somatic risk factors for pain chronification ('yellow flags'; e.g., depressiveness, pain-related cognition, passive pain behaviour, workplace-related factors, iatrogenic factors) is recommended [19].

A0025 – How is chronic low back pain currently managed according to published guidelines and in practice?

konservative Behandlungsmethoden reichen von medikamentösen zu nicht-medikamentösen Therapien

Conservative treatment options for chronic low back pain may include pharmaceuticals (drug therapy [19]),

- non-steroidal antirheumatics/antiphlogistics (tNSAR),
- and, if applicable, opioid analgesics, muscle relaxants, or antidepressants,

or non-drug therapies [19],

- physical activity and movement therapy,
- therapeutic exercise,
- patient education (information/training),
- ergonomics,
- multimodal, multi-, and interdisciplinary treatment/rehabilitation,
- self-management programmes,
- occupational therapy,
- behavioural therapy, or
- progressive muscle relaxation.

invasive Maßnahmen werden nicht empfohlen

According to this guideline, invasive therapeutic procedures are not recommended for the treatment of patients with nonspecific low back pain [19], due to the lack of reliable data (despite of numerous studies) for percutaneous procedures and the lack of studies on the use of surgical procedures.

Einzelmaßnahmen werden als nicht ausreichend angesehen, langfristige Folgen (z. B. Krankenstände) zu verhindern

The Austrian Guideline for the management of acute and chronic non-specific low back pain, published in 2011 [20], recommends multidisciplinary treatment programmes for chronic low back pain. Single interventions, such as pharmacological treatment only, are not considered to be sufficient to alleviating pain in the long term, as well as to prevent disability and work absences [20].

Target population

A0007 – What is the target population in this assessment?

Zielpopulation dieses Berichts sind Erwachsene mit LBP >3 Monaten und entsprechender vorangehender Diagnostik

The target population in this assessment are adult patients with chronic low back pain (longer than three months), who had a positive response to a diagnostic block in the sacroiliac or facet joints. Patients with acute trauma, fracture, malignancy, and inflammatory disease were excluded [1].

A0023 – How many people belong to the target population?

¼ der ÖsterreicherInnen innerhalb eines Jahres betroffen; Lebenszeitprävalenz von Rückenschmerzen bis zu 84 %

According to a health survey conducted by Statistik Austria in 2014, 23% of Austrian men and 26% of Austrian women were affected by chronic low back pain or other chronic back problems in the last 12 months. The prevalence increases with age and more women are affected than men [22]. The lifetime prevalence of low back pain (in total) is estimated to be up to 84% [16].

Anteil an Schmerzen im Bereich der Facetten- bzw. Iliosakralgelenke letztlich unklar

Prevalence-estimates of facet or sacroiliac joint pain are provided by the RFD studies' authors as follows: thus, facet-joint pain accounts for 15% to 50% [6, 23, 24] and sacroiliac joint pain for 15-20% [4, 25] of low back pain. Against the backdrop of the high prevalence of degenerative changes detected in facet joints (63% in a sample of 188 men and women, at mean ~52 years old [21]) or sacroiliac joints (65% in a sample of 373 men and women, at mean ~58 years old [26]) of the general population, the provided (high) proportion of

'facet or sacroiliac joint pain' as causes of low back pain can be questioned. Due to non-specific imaging and clinical testing reliable epidemiological data seems to be missing.

A0011 – How much is radiofrequency denervation of the facet and sacroiliac joints utilised?

Frequenz der Iliosakral-RFD von einreichender Institution auf ~ 40/Jahr geschätzt; für Gesamtösterreich keine Schätzungen (weder für Facetten- noch Iliosakral-Gelenke)

According to the information provided by one Austrian hospital, the annual frequency in this hospital is estimated to be 40 procedures of sacroiliac joint radiofrequency denervation. In 2014, 20 treatments were recorded in the submitting hospital. No estimations were provided regarding the annual frequency in Austria in total. The number of procedures of facet joint radiofrequency denervation in Austrian hospitals is unknown.

5 Clinical effectiveness

5.1 Outcomes

The following outcomes were defined as *crucial* to derive a recommendation:

- pain
- functional status
- global improvement
- health-related quality of life

als entscheidende Ergebnisparameter wurden Schmerz, Funktionalität, allgemeine Verbesserung und die gesundheitsbezogene Lebensqualität definiert

Changes in **pain** intensity were measured in all included studies using the Visual Analogue Scale (VAS) or the Numeric Rating Scale (NRS). The VAS is a continuous scale comprised of a horizontal or vertical line, usually 10 cm in length. Numbers or verbal descriptors at intermediate points are not recommended. The NRS (used in [2] and [4, 25]) is a segmented numeric version of the VAS. The most commonly used is the 11-item NRS, an 11-point numeric scale with 0 representing "no pain" and 10 representing "worst pain imaginable" [27]. One study used the Visual Numeric Pain Scale (VNS) for pain measurement [23].

Schmerz wird meist mit der Visual Analogue Scale (VAS) bestimmt

The **functional status** was measured using the Oswestry disability index score (ODI) in 7 of the included studies. The ODI was published in 1980 and has been widely used as a condition-specific outcome measure for patients with spinal disorders. It is comprised of 10 items (including pain intensity, personal care, walking, sleeping, social life, ...) with associated statements for the patient to select, which reflect the patient's ability to manage their everyday life. A maximum score of 50 is possible. The score can also be expressed as a percentage score (0-20% means minimal disability, 81-100% means that the patient is bed-bound) [28].

zur Abbildung der Funktionalität ist der Oswestry disability index (ODI) weit verbreitet

As '**global improvement**' is a non-specific outcome, study authors used different tools to determine potential effects. For assessing the 'global perceived effect' (GPE, used in two studies [4, 25]), three questions are asked (1. My pain has improved/worsened/stayed the same since my last visit; 2. The treatment I received improved/did not improve my ability to perform daily activities; 3. I am satisfied/not satisfied with the treatment I received and would recommend it to others.). Three studies used 4-7 point scales to determine a change in the 'global effect on back pain'[29], the 'subjective global assessment' [30]/ the 'global perceived effect'[6].

die allgemeine Verbesserung ist unspezifisch und kann mit unterschiedlichen Instrumenten erhoben werden

Health related quality of life (generic or disease-specific) can be assessed by various standardised instruments. Studies included in this review used EQ-5D [23], SF-36 [29], and AQoL [4].

zur Messung der HRQoL existieren zahlreiche standardisierte Instrumente

The outcomes

- patient satisfaction and
- ability to work

were defined as *important, but not crucial* to derive a recommendation.

als wichtig (nicht entscheidend) wurden Patientenzufriedenheit und Arbeitsfähigkeit definiert

5.2 Included studies

Facet joint pain: study and patient characteristics

Schmerzen im Bereich der Facettengelenke: 10 RCTs

Overall, we included 10 studies that evaluated radiofrequency denervation for facet joint pain [2, 5, 6, 23, 24, 29-33]. All studies were randomised controlled trials. 6 [5, 6, 29-32] compared radiofrequency denervation with a placebo/ sham treatment, the remaining 4 studies used steroid injections as the comparator [2, 23, 24, 33].

- 6 RFD vs. Plazebo (1994-2008, 323 PatientInnen)

- 4 RFD vs. Steroid-injektionen (2012-2014, 356 Patientinnen)

3 trials were conducted in Turkey [5, 23, 33], 2 in the Netherlands [6, 29], and the remaining 5 studies in Canada, Germany, Iran, Sweden, and the UK. The two Dutch studies were nationally funded [6, 29], the Swedish, German and Canadian study stated no (industry) funding [24, 30]/academic research [32], the remaining 5 studies did not provide funding information. The placebo controlled trials were published between 1994 and 2008, the remaining 4 studies between 2012 and 2014. Sample sizes of the placebo-controlled trials ranged from 31 to 81, those with the injection control groups included more patients by trend (80-120 each, except for one trial with only 56 patients). The total number of patients was 323 patients in the 6 placebo-controlled and 356 in the 4 steroid injection controlled trials.

Einschlusskriterien unterschiedlich v. a. hinsichtlich vorangehender Schmerzdauer

Inclusion criteria differed considerably between studies. In the placebo-controlled trials, patients hat to suffer from back pain for more than 3 months [31, 32] up to at least 2 years [30] (>6 months [5, 29], >12 months [6]). In the trials with the steroid injection control, patients had to suffer from back pain for more than 6 months [2, 33] to >2 years in [24] (not dependant on the total duration of complaints, but no response to conservative treatment for up to 6 weeks in [23]).

mittleres Alter 41-64 Jahre (in den Injektionsstudien tendenziell etwas älter); mit Ausnahme einer Studie Frauenanteil >55 %; Beobachtungszeitraum bis zu 12 Monate

The mean age of included patients ranged from 41 to 61 years in the placebo controlled trials, 50 to 64 years in the steroid injection controlled trials. Patients in the latter studies were slightly older: none of these studies show mean ages below 50 years in comparison to 3 of the 6 placebo-controlled trials. The percentage of female participants was more than 55% in all but one (steroid comparison) trial (35-39%) [24] with a maximum of up to 75% in [29]. Patient follow-up ranged from 3 [32] to most commonly 12 months (in half of the placebo-controlled [5, 6, 29] as well as steroid controlled [23, 33] trials).

Loss to follow-up ranged from 0% [5, 23, 29, 30] to 10% in [24], 2 trials did not report drop-outs [31, 33].

Facet joint pain: quality assessment

die Hälfte der RCTs weist hohes Bisasrisiko auf

4 of 6 placebo-controlled and 1 of 4 steroid-injection controlled trials have been judged to have a low risk of bias on a single study level. The remaining 5 studies [2, 23, 30, 31, 33] involve a high bias risk, e.g., due to unclear blinding (where possible), unclear or high number of drop-outs, or differing baseline characteristics.

Characteristics of included studies are displayed in Table A-1 and Table A-2.

Sacroiliac joint pain: study and patient characteristics

For evaluating radiofrequency denervation for sacroiliac joint pain, 2 randomised controlled trials fulfilled the inclusion criteria [4, 25]. Both RCTs compared radiofrequency denervation with placebo/sham treatment. They were published 2008-2012, conducted in the US and funded by Baylis Medical. The total number of patients was 79. Both RCTs included patients who had low back pain lasting for 6 months or longer and who had not achieved adequate improvement after conservative therapies.

Schmerzen im Bereich der Iliosakralgelenke:

2 RCTs, beide Plazebo-kontrolliert (2008-2012, 79 PatientInnen)

The mean age of patients was 52-64 years. 57-82% of the patients were female. Length of follow-up was 6 [25] and 9 months [4]. However, patients of the control group were given the opportunity to cross-over after 1 [25] or 3 [4] months.

mittleres Alter 52-64 Jahre, Frauenanteil 57-82 %; Beobachtungszeitraum (durch cross-over) 1-3 Monate

No lossestofollow-up were observed up to 3 months.

Sacroiliac joint pain: quality assessment

One RCT was judged to have a low bias risk [4], whereas the other RCT [25] might imply a high risk due to differing baseline characteristics.

1 der 2 RCTs mit hohem Bisarisiko

Characteristics of included studies are displayed in Table A-4.

5.3 Results

Mortality

D0001 – What is the expected beneficial effect of radiofrequency denervation on mortality? and

D0003 – What is the effect of radiofrequency denervation on the mortality due to causes other than low back pain?

Mortality is not a relevant outcome for assessing the clinical effectiveness of radiofrequency denervation, since neither the disease nor the intervention is life-threatening. Therefore, none of the included studies reported this outcome.

Mortalität: für die vorliegende Fragestellung kein relevanter Endpunkt

Morbidity (Pain)

D0005 – How does radiofrequency denervation affect symptoms and findings (severity, frequency) of chronic low back pain?

Facet joint pain

All 6 placebo-controlled trials report pain outcomes as changes in VAS score. Up to one month, one study reports statistically significant group differences in favour of the intervention at the post procedure observation point (conventional or pulsed RFD compared to placebo) [5]. One month after the intervention, statistically significant group differences are only observed in a subgroup comparison of one trial [31], whereas the third study doesn't observe a statistically significant group difference [32] (The overall estimate up to/including one month post intervention is statistically significant in favour of the intervention: MD -1.47 [-2.28, -0,67]). In the time period up to 6 months, only one [6] trial (of the three studies that report VAS group differences in this observation period) finds a statistically significant group difference (the overall estimate is n.s.: MD -0.71 [-2.25, 0.84]) [6, 29, 32]. At 6 months, 2 [5, 31] of 3 trials report statistically significant group differences, but the over-

Schmerz: Facettengelenke/RFD vs. Plazebo (6 RCTs):

bis zu 1 Monat: insgesamt signifikant zu Gunsten der Intervention

danach insgesamt nicht signifikante Gruppenunterschiede (einzelne Studien kommen zu widersprüchlichen Ergebnissen)

all estimate remains marginal, non-significant (MD -0.70 [-1.48, 0.08] [5, 30, 31]). A twelve months result is only provided by one trial, which reports a statistically significant difference only between the placebo and the conventional RFD group (not in comparison with the pulsed RFD group; overall: MD -0.96 [-0.04, 0.12]) [5].

Facettengelenke/RFD vs. Steroidinjektionen (3 RCTs):

in allen Beobachtungszeiträumen signifikant zu Gunsten der Intervention

In comparison to steroid injections, both studies that report pain outcomes at ≤1 month find statistically significant group differences (overall estimate MD: -1.81 [-3.05, -0.58]) [23, 33]. Overall estimates for group differences at 6 and 12 months are also statistically significant (at 6 months [23, 24, 33]: MD -2.13 [-3.45, -0.81], only one trial reported a n.s. difference [24]); at 12 months [23, 33]: MD -2.65 [-3.43, -1.88]). The remaining trial [2] states significant group differences at 12 weeks and 6 months (not at 6 weeks), but doesn't provide detailed data.

Sacroiliac joint pain

Iliosakralgelenke/RFD vs. Plazebo (2 RCTs):

n.s. nach 1 Monat (widersprüchliche Studienergebnisse); signifikant zu Gunsten der Intervention nach 3 Monaten (nur 1 Studie)

At one month, one study [25] reported a significant reduction in pain, whereas the second study [4] was not able to detect a significant group difference (overall estimate MD -2.21 [-5.34, 0.92]). Meaningful results at 3 months can only be provided by one of the two trials [4] (which reports a significant group difference; MD -1.30 [-2.06, -0,54]). At this observation point, data of the second trial is without value for the comparison due to cross over (only three patients of the original placebo group declined to cross over to the RFD group) [25].

D0006 – How does radiofrequency denervation affect progression (or recurrence) of chronic low back pain?

Auswirkungen auf Progression/ Wiederauftreten der Beschwerden ist aufgrund fehlender Langzeitdaten unbekannt

Due to the lack of long-term follow-up data (>12 months), this question cannot be answered.

Functional status

D0016 – How does the use of radiofrequency denervation affect activities of daily living?

Facet joint pain

Funktionalität:

Facettengelenke/RFD vs. Plazebo (3 RCTs)

n.s. <6 Monate, danach (≤12 Monate) signifikant zu Gunsten der Intervention, jedoch basierend auf 1 Studie

3 of the 6 placebo-controlled trials report ODI outcomes [5, 6, 32][2]. One study [5] observes significant group differences between the RFD and control groups post procedure, as well as at 6 and 12 months. A statistically significant group difference has also been reported in the second trial 8 weeks post intervention. On the contrary, the third study wasn't able to detect statistically significant group differences (neither at 4, nor at 12 weeks) [32]. Overall estimates at the different observation periods are non-significant within the first 6 months (≤1 month: MD -3.45 [-7.68, 0.77]; >1 to <6 months: MD -9.48 [-28.73, 9.76]; 2 studies each) and significant in favour of the intervention in the following 6 months (based on one trial). A forth study reported functional status as 'mean change in physical activity' [29] at 3 months (n.s. group difference), the remaining 2 studies did not report this outcome [30, 31].

[2] in [18] a n.s. group difference (-3.13 vs. -1.62) was reported, when the functional status was measured by the COOP/WONCA Functional Assessment Charts at 8 weeks (in contrary to the s. difference if measured by ODI)

In comparison to steroid injections, only one trial provides data [24] (for only one observation point at 6 months) and does not find a statistically significant group difference (MD: -5.00 [-15.19, 5.19]). The most recent trial [2] reports statistically significant group differences at 12 weeks and 6 months (n.s. at 6 weeks), but doesn't provide detailed data (results are shown in a figure only). The remaining 2 studies did not report this outcome [23, 33].

Facettengelenke/RFD vs. Steroidinjektionen (1 RCT)

n.s. 6 Monate post Intervention (keine anderen Beobachtungszeitpunkte verfügbar)

Sacroiliac joint pain

Both trials provide ODI data [4, 25] and both report statistically significant group differences at 1 month (if changes from baseline are compared; the overall effect for the group comparisons at 1 month is n.s.: MD -14.06 [-30.42, 2.30]). Meaningful results at 3 months can only be provided by one of the two trials [4] (still significant difference; MD -11.00 [-17.91, -4.09]), whereas at this observation point, data of the second trial is without value for the comparison due to cross over (only three patients of the original placebo group declined to cross over to the RFD group)[25].

Iliosakralgelenke/RFD vs. Plazebo (2 RCTs)

insgesamt n.s. 1 Monat post Intervention (die beiden Einzelstudien berichten jedoch s. Verbesserungen), s. zu Gunsten der Intervention nach 3 Monaten (hier 1 Studie)

Global improvement

D0005 – How does radiofrequency denervation affect symptoms and findings (severity, frequency) of chronic low back pain?

In addition to changes in pain or functional status, overall 'global improvement' has been assessed in 5 (placebo-controlled) trials with different instruments (no overall estimates provided).

Allgemeine Verbesserung:

Facet joint pain

In an observation period of 2-6 months post intervention, 3 studies reported significant global improvements in the RFD group compared to the placebo control [6, 29, 30].

Facettengelenke/RFD vs. Plazebo (3 RCTs): s. Gruppenunterschiede nach 2-6 Monaten

Sacroiliac joint pain

In an observation period of 1-3 months post intervention, each study reports significant global improvements in the RFD group compared to the placebo control [4, 25].

Iliosakralgelenke/RFD vs. Plazebo: s. besser nach 1 bzw. 3 Monaten (je ein RCT)

Health-related quality of life

D0012 – What is the effect of radiofrequency denervation (RFD) on generic health-related quality of life?

Facet joint pain

One placebo-controlled study [29] on facet joint pain used the SF-36 to measure quality of life at 3 months post intervention and did not observe statistically significant group differences (except for the item vitality).

One study comparing RFD in facet joints with steroid injections didn't find any statistically significant differences in quality of life assessed by the EQ-5D (at 1, 6 and 12 months) [23].

The remaining 8 studies did not report this outcome.

Lebensqualität (generisch): Facettengelenke/RFD vs. Plazebo: 1 RCT, n.s. nach 3 Monaten; vs. Steroidinjektion (1 RCT): n.s. nach 1-12 Monaten

Sacroiliac joint pain

Iliosakralgelenke/RFD vs. Plazebo: 1 RCT, n.s. nach 1, s. nach 3 Monaten

One of the two studies on RFD in SI joints used the AQoL instrument and reported no difference at one, but a statistically significant difference at 3 months [4]. The second study did not report this outcome [25].

D0013 – What is the effect of radiofrequency denervation on disease-specific quality of life?

Lebensqualität (indikations-spezifisch): Effekt aufgrund fehlender Daten unbekannt

None of the studies reported on disease-specific quality of life.

Ability to work

D0016- How does the use of radiofrequency denervation affect activities of daily living?

Arbeitsfähigkeit: Effekt aufgrund fehlender Daten unbekannt

In addition to the measurement of the functional status (see above), this question should have been answered by the outcome "ability to work", but none of the RCTs reported this outcome.

Patient satisfaction

D0017 – Was the use of radiofrequency denervation worthwhile?

PatientInnen-zufriedenheit

To answer this research question, the outcome "satisfaction with treatment" was used.

Facet joint pain

Facettengelenke/RFD vs. Plazebo (1 RCT): „s. besser" (ohne Daten)

The outcome was reported in 1 of 6 placebo controlled RCTs on RFD in facet joints and 3 of 4 RCTs comparing RFD with steroid injections in facet joints.

Compared to the placebo intervention, one study reported significantly higher patient satisfaction (≥1 month) in the intervention group without providing detailed data [5].

vs. Steroidinjektion (3 RCTs): widersprüchliche Studienergebnisse, tendenziell zu Gunsten der Intervention

Compared to steroid injections one study [23] reported no difference in patient satisfaction at 1 and 6 months (whereas the 12 month result favoured RFD). The remaining two studies found significant group differences in favour of RFD at all observation points (after 12 weeks and 6 months [2], at 1, 6 and 12 months [33]).

Sacroiliac joint pain

Iliosakralgelenke/RFD vs. Plazebo: Effekt aufgrund fehlender Daten unbekannt

The two RCTs assessing RFD in the sacroiliac joint did not report on patient's satisfaction with treatment [4, 25].

6 Safety

6.1 Outcomes

The following outcome was defined as *crucial* to derive a recommendation:

- Complications

The outcome 'complications' is non-specific and includes direct intervention-related side-effects (e.g., during or immediately after the intervention), as well as any other negative consequences observed in the follow-up period.

für den Bereich Sicherheit wurden ‚Komplikationen' als entscheidender Ergebnisparameter definiert

6.2 Included Studies

Facet joint pain: study and patient characteristics

In addition to the 10 studies [2, 5, 6, 23, 24, 29-33] that we had already included for the clinical effectiveness assessment, we included 3 further RCTs [34-36] for the safety analysis. All of these studies compared different RFD methods (continuous vs. pulsed RFD [34], a distal vs. a tunnel vision approach for RFD [35] and an intra-articular vs. extra-articular RFD [36]).

Schmerzen im Bereich der Facettengelenke: 13 RCTs: 10 (siehe Wirksamkeit) + 3 RCTs, die unterschiedliche RFD Methoden verglichen (1999-2013, 166 PatientInnen)

The trials were conducted in the US [34], Korea [35] and the Netherlands, [36] and published between 1999 [36] and 2013 [35]. Sample sizes ranged from 34 [36] to 82 [35]. The total number of patients was 166. Inclusion criteria varied between studies. Patients had to suffer from back pain for more than 1 [34], 3 [35], or 6 months [36].

The mean age of included patients ranged from 57 to 69 years. The percentage of female participants differed considerably between and within studies (24-29% [36], 46-62% [34] and 62-72% [35]). Patient follow-up ranged from 3 [34, 36] to 6 [35] months, loss to follow-up was from 12-15% [35] to 48% in [34] ([36]did not report drop-outs).

Alter: 57-69 Jahre, Frauenanteil 24-72 %; Drop-out in einer Studie 48 %

Facet joint pain: quality assessment

All 3 RCTs were judged to have a high risk of bias due to the unclear/high number of drop-outs, unclear blinding, and allocation concealment processes.

alle 3 RCTs mit hohem Biasrisiko

For the study and patient characteristics of the further 10 RCTs, see the description of included studies in the section on clinical effectiveness.

Study characteristics and results of included studies are displayed in Table A-1, Table A-2, and Table A-3, and in the evidence profile in Table 7-3.

Sacroiliac joint pain: study and patient characteristics

The 12 month follow up [3] of Patel 2012 [4] (which could have been included for safety issues despite cross-over) didn't provide any safety data. Therefore, we included the same 2 RCTs [4, 25] (that we had already included for the clinical effectiveness assessment) for evaluating the safety of RFD for sacroiliac joint pain (see 5.2).

Schmerzen im Bereich der Iliosakralgelenke: 2 RCTs (siehe Wirksamkeit)

Study characteristics and results of included studies are displayed in Table A-4 and in the evidence profile in Table 7-5.

6.3 Results

Patient safety

C0008 – How safe is radiofrequency denervation in comparison to placebo or steroid injections?

RFD for facet joint pain (compared to placebo)

Komplikationen:

5 of the 6 placebo controlled studies reported no complications at all [5, 6, 30-32]. The remaining study observed no significant group differences 'in the occurrence of treatment-related pain and subjective sensory or motor changes' [29].

Facettengelenke/RFD vs. Plazebo (6 RCTs): „keine Komplikationen/ Gruppenunterschiede"

RFD for facet joint pain (compared to steroid injections)

vs. Steroidinjektionen (3 RCTs): „keine Komplikationen" bzw. selten oberflächliches Brennen/stärkere postinterventionelle Schmerzen bei RFD

2 studies observed no complications/adverse events [24, 33]. Study authors of one trial stated that no infections or new motor or sensory deficits occurred, rare complaints of small superficial burns after RFD were reported, and an increase in severity of low back pain had been observed in 2 RFD group patients (of 50; 4%) in the early follow-up period [23]. The remaining trial did not report safety outcomes [2].

RFD for sacroiliac joint pain (compared to placebo)

None of the two studies reported any serious complications [4, 25].

Iliosakralgelenke/RFD vs. Plazebo (6 RCTs): „keine schwerwiegenden Komplikationen"

Authors of one study state that 'a majority of patients reported temporary worsening pain' (procedure-related pain and/or temporary neuritis up to 5-10 days after the procedure). It can be assumed, but it is not clearly stated, that/if this observation was made for both groups. In addition, they report 'one patient reported transient nonpainful buttock paresthesia that resolved without therapy' (=1/25 pts. due to crossover (4%))[25].

stärkere postinterventionelle Schmerzen/ggfs. Taubheitsgefühl

The second study only reports a 'small proportion of subjects with soreness or numbness at the introducer sites in the 2 weeks following treatment' and that one patient developed shingles at the introducer site (seen as unrelated to the treatment) [4]. Again, a between group distinction cannot be made because this information has not been provided.

C0002 – Are there harms related to dosage or frequency of applying radiofrequency denervation?

Facet joint pain

Unterschiede bezüglich Dosis/Häufigkeit der Anwendung:

The trial comparing continuous RFD (performed at 80° C for 75 seconds) with pulsed RFD (at 42° C with pulse duration of 20 milliseconds and pulse rate of 2 Hz for 120 seconds) did not encounter any adverse event (in any group) during the intervention or up to 3 months post-procedure (this observation relies on the 26 of 50 patients (only 52%) who completed the 3 months follow-up) [34].

Vergleiche von pulsed vs. continous RFD sowie von intra- und extraartikulärer RFD berichten von „keinen Komplikationen"

The trial comparing intra- with extra-articular RFD stated that with 'no complications' were observed (34 patients, 3 months observation period, loss to follow-up not reported)[36].

The direct comparison of two techniques (distal vs. tunnel vision approach) found one complication (2%) in the distal approach group (localised pain) and 5 complications (10%) in the tunnel vision approach group (2 patients with localised pain and 3 with new neuropathy-like pain lasting >3 months) during the 6-month follow-up [35]. However, this group difference was not statistically significant.

Vergleiche von distal vs. tunnel vision approach berichten von mehr (n.s.) Komplikationen mit letzterer Technik

Sacroiliac joint pain

No evidence was identified to answer the research question.

C0004 – How does the frequency or severity of harms change over time or in different settings?

Veränderung durch verschiedene Settings/im Zeitverlauf unbekannt

No evidence was identified to answer the research question.

C0005 – What are the susceptible patient groups that are more likely to be harmed through the use of radiofrequency denervation?

vulnerable Gruppen unbekannt

No evidence was identified to answer the research question.

C0007 – Are radiofrequency denervation, placebo interventions, or steroid injections associated with user-dependent harms?

AnwenderInnen-bedingte Komplikationen unbekannt

No evidence was identified to answer the research question.

7 Quality of evidence

Qualität der Evidenz nach GRADE

The strength of evidence was rated according to GRADE (Grading of Recommendations Assessment, Development and Evaluation) scheme [37] for each endpoint individually. Each study was rated by two independent researchers. In case of disagreement a third researcher was involved to solve the difference. A more detailed list of criteria applied can be found in the recommendations of the GRADE Working Group [37].

GRADE uses four categories to rank the strength of evidence:

- **High** = We are very confident that the true effect lies close to that of the estimate of the effect;
- **Moderate** = We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different;
- **Low** = Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect;
- **Very low** = Evidence either is unavailable or does not permit a conclusion.

The ranking according to the GRADE scheme for the research question can be found in Table 7-1 to Table 7-5.

RFD for facet joint pain

Facettengelenks-RFD vs. Plazebo

Overall, the strength of evidence for the effectiveness and safety of radiofrequency denervation for **facet joint pain in comparison to placebo** (sham intervention) is **low**:

insgesamt geringe Evidenz, z. B.: kurzfistige Schmerzreduktion (<1 Monat), nicht längerfristig

There is **low evidence** that RFD compared to placebo

- might reduce pain in the short term (≤1 month), but not in the intermediate term (>1 to 12 months),
- might not increase functional status <6 months, but between 6 to 12 months,
- might not improve quality of life at 3 months,
- might lead to a global improvement in the intermediate term (>1 up to 6 months).

sehr geringe Evidenz, dass Komplikationen nicht zunehmen

There is **very low evidence** that RFD compared to placebo

- might not increase complications.

For the outcome quality of life and global improvement (≤1 and >6 months), **no evidence** is available.

Facettengelenks-RFD vs. Steroidinjektionen

1. Overall, the strength of evidence for the effectiveness and safety of radiofrequency denervation for **facet joint pain in comparison to steroid injections** is **low to very low**:

   insgesamt (sehr) geringe Evidenz, z. B.: Schmerzreduktion bis zu 1 Jahr, keine Funktionalitätsverbesserung

   There is **low evidence** that RFD compared to steroid injections

   - might reduce pain up to 12 months post intervention.

sehr geringe Evidenz, dass keine (schwerwiegenden) Komplikationen auftreten

There is **very low evidence** that RFD compared to steroid injections

- might not improve the functional status in the intermediate term (≥6 to <12 months),
- might not improve quality of life up to 12 months,
- does not lead to complications/major adverse events, infections or motor or sensory deficits, but might cause superficial burns after the intervention and an initial increase in back pain.

keine Evidenz zu allgemeiner Verbesserung

For the outcome global improvement, **no evidence** is available (as well as for: pain >1 to <6 months, functional status <6 and ≥12 months and health related quality of life >1 to <6 months).

2. Based on studies that **compared different RFD techniques,** there is **very low evidence** of no complications/major adverse events, but mild localised pain (<1 month) or neuropathy like pain (>3 months) had been observed in 2-12% of patients.

RFD for sacroiliac joint pain

Iliosakralgelenks-RFD vs. Plazebo

1. Overall, the strength of evidence for effectiveness and safety of radiofrequency denervation for **sacroiliac joint pain in comparison to placebo** (sham intervention) is **low to very low**:

insgesamt (sehr) geringe Evidenz, z. B.: Schmerzreduktion und Funktionalitätsverbesserung >1 bis < 3 Monate

There is **low to very low evidence** that RFD compared to placebo

- might not reduce pain or improve functional status in the short term (≤1 month), but thereafter up to 3 months,
- might lead to a global improvement up to 3 months,
- might not increase quality of life up to 1, but up to 3 months.

sehr geringe Evidenz, dass keine (schwerwiegenden) Komplikationen auftreten

There is **very low evidence** that RFD compared to placebo

- might not increase serious complications.

keine Evidenz >3 Monate

No evidence is available for all critical outcomes (pain, functional status, global improvement, health related quality of life) in an observation period of >3 months.

Table 7-1: Evidence profile for RFD vs. placebo: efficacy in patients with facet joint pain

No of studies/patients	Study Design	Estimate of effect	Study limitations	Inconsistency	Indirectness	Other modifying factors	Strength of evidence
Efficacy (RFD vs. placebo)							
pain							
pain intensity (VAS), ≤1 month							
3/160 (94 vs. 66) [5, 31, 32]	RCT	**MD -1.47 [-2.28, -0,67]**	0	-1	0	-1[1]	low
pain intensity (VAS), >1 to <6 months							
3/182 (91 vs. 91) [6, 29, 32]	RCT	MD -0.71 [-2.25, 0.84]	0	-1	0	-1[1]	low
pain intensity (VAS), ≥6 to <12 months							
3/130 (78 vs. 52) [5, 30, 31]	RCT	MD -0.70 [-1.48, 0.08]	0	-1	0	-1[1]	low
pain intensity (VAS), ≥12 months							
1/60 (40 vs. 20) [5]	RCT	MD -0,96 [-0,04, 0.12]*	0	-1 (NA)	0	-1[1]	low
functional status							
functional status (ODI), ≤1 month							
2/130 (76 vs. 54) [5, 32]	RCT	MD -3,45 [-7,68; 0,77]*	0	-1	0	-1[1]	low
functional status (ODI), >1 to <6 months[3]							
2/101 (51 vs. 50) [6, 32]	RCT	MD -9.48 [-28.73; 9.76][4]*	0	-1	0	-1[1]	low
functional status (ODI), ≥6 to < 12 months							
1/60 (40 vs. 20) [5]	RCT	**-3,7 [-6,94;-0,47]***	0	-1 (NA)	0	-1[1]	low
functional status (ODI), ≥12 months							
1/60 (40 vs. 20) [5]	RCT	**-5,33 [-8.56; -2.11]***	0	-1 (NA)	0	-1[1]	low
global improvement							
Global improvement, ≤1 month							
NR							
global improvement, >1 to <6 months							
2/112 (55 vs. 57) [6, 29]	RCT	**at 8 weeks** [6]**: 1,33 vs. 0,37 (s.)** **at 3 months** [29]**: 61.5% vs. 39.0% (s.)**	0	-1	0	-1[1]	low

[3] In addition, Van Wijk [27] reports mean changes in physical activity (as functional outcome) and finds n.s. group differences at 3 months

[4] VanKleef [20] didn't provide standard deviations (SD) for the ODI scores at 8 weeks. The shown calculation is based on the given SDs for the baseline data. The estimated effect remains comparable even if the SDs are halved (-9.95 [-29.22, 9.32]) or doubled (-7.64 [-26.38, 11.09]).

No of studies/patients	Study Design	Estimate of effect	Study limitations	Inconsistency	Indirectness	Other modifying factors	Strength of evidence
global improvement, ≥6 to <12 months							
1/40 (20 vs. 20) [30]	RCT	**at 6 months: -1.1 vs. -0,3 (s.)**	0	-1 (NA)	0	-1[1]	low
global improvement, ≥12 months							
NR							
health related quality of life							
health related quality of life, ≤1 month							
NR							
health related quality of life, >1 to <6 months							
1/81 (40 vs. 41) [29]	RCT	(SF-36 general health) at 3 months: 1.8 (13.6) vs. -1.3 (17.5) (n.s.)	0	-1 (NA)	0	-1[1]	low
global improvement, ≥6 to <12 months							
NR							
health related quality of life, ≥12 months							
NR							
ability to work							
NR							
satisfaction with treatment							
1/60 (40 vs. 20) [5]	RCT	**"higher in IGs than CGs" (s.)**	0	-1 (NA)	0	-1[1]	low
complications (RFD vs. placebo)							
6/323 (175 vs. 148) [5, 6, 29-32]	RCT	5 of 6 studies reported "no complications", 1 study [29] reported "no significant differences between groups"	0	-1	0	-1[1]	low

* *own calculation;*

[1] *downgraded due to imprecise data;* ***bold****font indicates statistically significant group difference(s.)*

Nomenclature for GRADE table:

Limitations: 0: no limitations or no serious limitations; -1: serious limitations

Inconsistency: NA: Not applicable (only one trial); 0: no important inconsistency; -1: important inconsistency

Indirectness: 0: direct, no uncertainty, -1: some uncertainty, -2 major uncertainty

Other modifying factors: publication bias likely (-1), imprecise data (-1)[1], strong or very strong association (+1 or +2), dose-response gradient (+1), Plausible confounding (+1)

Table 7-2: Evidence profile for RFD vs. steroid injections: efficacy in patients with facet joint pain

No of studies/patients	Study Design	Estimate of effect	Study limitations	Inconsistency	Indirectness	Other modifying factors	Strength of evidence
Efficacy (RFD vs. steroid injections)							
Pain							
pain intensity (VAS), ≤1 month							
2/180 (90 vs. 90) [23, 33]	RCT	**MD -1.81 [-3.05, -0,58]***+**	-1	0	0	-1[1]	low
pain intensity (VAS), >1 to <6 months							
NR**							
pain intensity (VAS), ≥6 to <12 months							
3/232 (116 vs. 116) [23, 24, 33]	RCT	**MD -2.13 [-3.45, -0.81]****	-1	0	0	-1[1]	low
pain intensity (VAS), ≥12 months							
2/180 (90 vs. 90) [23, 33]	RCT	**MD -2.65 [-3.43, -1.88]**+**	-1	0	0	-1[1]	low
Functional status							
Functional status, ≤1 month							
NR							
Functional status, >1 to <6 months							
NR**							
functional status (ODI), ≥6 to <12 months							
1/52 (26 vs. 26) [24]	RCT	MD -5.00 [-15.19, 5.19]**	-1	-1 (NA)	0	-1[1]	very low
functional status, ≥12 months							
NR							
Global improvenement							
NR							
Health related quality of life							
Health related quality of life, ≤1 month							
1/100 (50 vs. 50) [23]	RCT	-8.2 vs -8.7 (n.s.)	-1	(-1) NA	0	-1[1]	very low
Health related quality of life, >1 to <6 months							
NR							
Health related quality of life, ≥6 to <12 months							
1/100 (50 vs. 50) [23]	RCT	-7.3 vs -7.5 (n.s.)	-1	(-1) NA	0	-1[1]	very low

No of studies/patients	Study Design	Estimate of effect	Study limitations	Inconsistency	Indirectness	Other modifying factors	Strength of evidence
Health related quality of life, ≥12 months							
1/100 (50 vs. 50) [23]	RCT	-7.1 vs -6.7 (n.s.)	-1	(-1) NA	0	-1[1]	very low
ability to work							
NR							
satisfaction with treatment* **							
satisfaction with treatment, ≤1 month							
1/100 (50 vs. 50) [23] 1/120 (80 vs. 40) [33]	RCT	at 1 month: 1.3 vs. 1.3 (n.s.) [23] **3.2 vs. 2.6 (s.)** [33]	-1	-1	0	-1[1]	very low
satisfaction with treatment, >1 to <6 months							
1/80 (40 vs. 40) [2]	RCT	**at 12 weeks: higher in IG than KG (s.)**	-1	(-1) NA	0	0	very low
satisfaction with treatment, ≥6 to <12 months							
1/80 (40 vs. 40) [2] 1/100 (50 vs. 50) [23] 1/120 (80 vs. 40) [33]	RCT	at 6 months: **higher in IG than KG (s.)** [2] 1.4 vs. 1.7 (n.s.) [23] **3.2-3.6 vs. 2.7 (s.)** [33]	-1	-1	0	-1[1]	very low
satisfaction with treatment, ≥12 months							
1/100 (50 vs. 50) [23] 1/120 (80 vs. 40) [33]	RCT	at 12 months: **1.5 vs. 2.0 (s.)** [23] **3.1-3.2 vs. 2.70 (s.)** [33]	-1	0	0	-1[1]	very low

Abbreviations: MD mean difference; ODI Oswestry Disability Index; RCT randomized controlled trial; VAS Visual Analogue Scale;

[1] *downgraded due to imprecise data;* ***bold font*** *indicates statistically significant group difference(s.)*

* *own calculation;*

[+] *difference also significant between the RFD plus steroid injection and the injection only group (-4,2 vs. -1,7) [33]*

** *Hashemi et al [2] do not provide data for the between group differences for pain (VAS) and ODI at 6 weeks, 12 weeks and 6 months (only figure given). They state no significant group differences at 6 weeks (VAS p=0.75, ODI p=0,31), but significant group differences favoring the intervention at 12 weeks (VAS p=0.012; ODI p=0.022) and 6 months (VAS p=0.02; ODI p=0.03)*

*** *All three studies that reported patient satisfaction with treatment used a 4 point scale. In [2] and [33] a higher number indicates higher patient satisfaction (max. 4) whereas in [23] a lower NASS score (min. 1) reflects higher patient satisfaction.*

Table 7-3: Evidence profile for RFD vs. placebo, steroid injections or alternative RFD: safety in patients with facet joint pain

No of studies/patients	Study Design	Estimate of effect	Study limitations	Inconsistency	Indirectness	Other modifying factors	Strength of evidence
Safety							
complications (RFD vs. placebo)							
6/323 [5, 6, 29-32]	RCT	5 of 6 studies reported "no complications", 1 study [29] reported "no significant differences between groups"	-1	-1	0	-1[1]	very low
complications (RFD vs. steroid injections)							
3/276 [23, 24, 33]	RCT	no complications [33]; no major adverse events [24]; no infections or motor or sensory deficits [23]; rare complaints of superficial burns after RFD [23]	-1	-1	0	-1[1]	very low
complications (RFD vs. other RFD)							
3/142 [34-36]	RCT	no complications [36]/no major adverse events [34]; mild localised pain <1 month or neuropathy like pain >3 months: 1/41 distal vs. 5/41 tunnel vision approach [35]	-1	-1	0	-1[1]	very low

[1] *downgraded due to imprecise data*

Table 7-4: Evidence profile: efficacy of RFD vs. placebo in patients with sacroiliac joint pain

No of studies/patients	Study Design	Estimate of effect	Study limitations	Inconsistency	Indirectness	Other modifying factors	Strength of evidence
Efficacy							
Pain							
Pain intensity (NRS), ≤1 month							
2/79 (48 vs. 31) [4, 25]	RCT	MD -2,21 [-5.34, 0,92]*	-1	-1	0	-1[1]	very low
Pain intensity (NRS), >1 to <6 months							
1/51 (34 vs. 17) [4]	RCT	**MD -1.30 [-2.06, -0.54]**	0	-1 (NA)	0	-1[1]	low
pain intensity (NRS), ≥6 to <12 months							
NR							
pain intensity (NRS), ≥12 months							
NR							
Functionality							
Functional status (ODI), ≤1 month							
2/75 (46 vs. 29) [4, 25]	RCT	MD -14.06 [-30.42, 2.30]	-1	-1	0	-1[1]	very low

No of studies/patients	Study Design	Estimate of effect	Study limitations	Inconsistency	Indirectness	Other modifying factors	Strength of evidence
Functional status (ODI), >1 to ≥6 months							
1/49 (34 vs. 15) [4]	RCT	**MD -11.00 [-17.91, -4.09]**	0	-1 (NA)	0	-1[1]	low
Functional status (ODI), ≥6 to <12 months							
NR							
Functional status (ODI), ≥12 months							
NR							
Global improvement							
Global improvement (positive GPE % (95% CI)), ≤1 month							
1/18 (14 vs. 14) [25]	RCT	**93 (78-100) vs. 21 (2-45) (s.)**	-1	-1 (NA)	0	-1[1]	very low
Global improvement (positive GPE % (95% CI)), >1 to ≥6 months							
1/51 (34 vs. 17) [4]	RCT	**47 (29-65) vs. 8 (0-36) (s.)**	0	-1 (NA)	0	-1[1]	low
Global improvement (positive GPE % (95% CI)), ≥6 to <12 months							
NR							
Global improvement (positive GPE % (95% CI)), ≥12 months							
NR							
Health related quality of life							
Health related quality of life (AQoL), ≤1 month							
1/51 (34 vs. 17) [4]	RCT	0 (0.07 vs. 0.07 (n.s.))	0	-1 (NA)	0	-1[1]	low
Health related quality of life (AQoL), >1 to ≥6 months							
1/51 (34 vs. 17) [4]	RCT	**0.09 vs. 0.02 (s.)**	0	-1 (NA)	0	-1[1]	low
Health related quality of life (AQoL), ≥6 to <12 months							
NR							
Health related quality of life (AQoL), ≥12 months							
NR							
Ability to work							
NR							
Satisfaction with treatment							
NR							

Abbreviations: MD mean difference; ODI Oswestry Disability Index; RCT randomized controlled trial; VAS Visual Analogue Scale;

[1] *downgraded due to imprecise data;* ***bold font*** *indicates statistically significant group difference (s.); *own calculation*

Table 7-5: Evidence profile for RFD vs. placebo: safety in patients with sacroiliac joint pain

No of studies/patients	Study Design	Estimate of effect	Study limitations	Inconsistency	Indirectness	Other modifying factors	Strength of evidence
Safety							
complications (RFD vs. placebo)							
2/79 (48 vs. 31) [4, 25]	RCT	"no serious complications" [4, 25]; "majority with temporary worsening pain" [25]; "small portion of pts. with soreness or numbness" [4]; 1 (of 25 IG pts.) transient buttock paresthesia [25]	-1	-1	0	-1[1]	very low

[1] *downgraded due to imprecise data*

Nomenclature for GRADE table:

Limitations: 0: no limitations or no serious limitations; -1: serious limitations

Inconsistency: NA: Not applicable (only one trial); 0: no important inconsistency; -1: important inconsistency

Indirectness: 0: direct, no uncertainty, -1: some uncertainty, -2 major uncertainty

Other modifying factors: publication bias likely (-1), imprecise data (-1), strong or very strong association (+1 or +2), dose-response gradient (+1), Plausible confounding (+1)

8 Discussion

Interpretation of findings

Study quality, validity of endpoints, and overall level of evidence

Overall, the level of evidence for the estimated effects is very low to low. This conclusion is primarily based on the following observations:

insgesamt basieren die Effektschätzer auf einem geringen Evidenzlevel, da

Despite the chosen adequate study design (randomised controlled trials), the risk of bias of the majority of included single studies can be assumed to be high. While the placebo-controlled trials aimed at (and most likely succeeded in) blinding the patients and outcome assessors, the studies that compared RFD to steroid injection therapy inevitably carry this high bias risk because of the impossibility to conceal the group allocation from the patients. The relevance of this non-blinding is due to the implications for the validity of measured outcomes. All relevant, therefore chosen, and also reported efficacy outcome parameters (pain, functional status, overall improvement, health related quality of life and patient satisfaction) rely on patient self-report, which is likely to be susceptible to the knowledge of having or having not received the "best available" treatment. This effect might have led to the better results (by trend) in the facet-joint RFD vs. steroid injection comparisons than in those compared to the sham intervention. Better results for pain reduction observed in the comparison with a therapeutic comparator (steroid injections) than with a sham intervention (which is not likely to provide more than a placebo effect) seem otherwise hardly explainable, at least, as far as the population is comparable to a certain degree. Only a substantial change in the RFD technique over time (the steroid injection controlled facet joint RFD trials were published more recently) could have additionally influenced the outcomes in favour of the intervention (1 of 6 placebo-controlled, but 2 of 4 steroid injection controlled trials used a pulsed RFD technique).

- die eingeschlossenen Studien meist ein hohes Biasrisiko aufweisen (z. B. nicht mögliche Verblindung bei Injektionstherapie mit potentiellen Folgen für ausschließlich durch PatientInnenangaben erhobene Ergebnisse)

The number of included patients in placebo controlled facet joint RFD trials was ≤80, in steroid injection controlled trials (except for one trial) 80-120. The sacroiliac RFD trials were even smaller (28/51 patients). The small sample sizes might be adequately powered to detect considerable differences in the primary outcome (e.g., VAS differences for pain), but not for smaller effects or rare events (e.g., complications).

- die eingeschlossenen Studien geringe Stichprobenumfänge aufweisen

Relevance of the outcomes assessed to the potential patient-relevant benefits

All chosen and reported outcomes are patient-relevant. From a single patient, but also social perspective implications of the ability to work would have been of high interest, but haven't been reported in a single trial. (Costs and potentially adverse events-producing) Medication (analgetics) has been addressed in some of the studies, but has not been considered in this review (e.g., achieved reduction).

fehlende Daten zu Arbeitsfähigkeit; Medikation könnte auch von Gesundheitssystem-interesse sein

For reliable statements on effectiveness, long-term data would be essential to determine the mean period of the effect, which is assumed to be not permanent due to nerve recovery. These data should include outcomes like alternative (more invasive) therapies prevented (e.g., SI joint fusion). RCTs might not be able to provide the proposed long-term data, therefore prospective registries might be necessary to determine these effects.

Wirkungsdauer oder auch Verhinderung anderer Interventionen nur in Langzeit-beobachtungen (z. B. Registern) möglich

Factors that may influence the external validity

Übertragbarkeit der Ergebnisse potenziell eingeschränkt durch:

- **Unterschiede in den verwendeten RFD Methoden**

The two RCTs on RFD for sacroiliac joint pain used a "cooled radiofrequency denervation" method (with temperatures from 60 to 80° C and durations from 90 to 150 seconds). In the RCTs on RFD for facet joint pain, an even greater heterogeneity can be observed. Continuous or pulsed RFD methods (40-85° C, 60-120s) were applied (see Table 8-1). Different techniques result in different lesions and ongoing research focuses on these variable effects (see list of ongoing trials Table A-7 and Table A-8). It seems that (like in dose-finding studies of pharmaceuticals) the optimal "dose" of RFD is still under examination.

- **heterogene PatientInnenpopulation (v. a. Schmerzdauer)**

The patient population varied between studies, especially with regard to the duration of preceding pain (>3 months up to >2 years). These different levels of 'chronicity' could have an impact on the study results.

Table 8-1: Overview of RFD techniques, used in included RCTs

Author, year	Gallagher, 1994 [31]	Leclaire, 2001 [32]	Nath, 2008 [30]	Tekin, 2007 [5]	Van Kleef, 1999 [6]	Van Wijk, 2005 [29]
comparison	facet RFD vs. placebo					
intervention	NR (continuous)	NR (continuous)	NR (continuous)	continuous RFD/ pulsed RFD	NR (continuous)	NR (continuous)
temperature	80° C	80° C	85° C	80° C/42° C	80° C	80° C
duration	90 seconds	90 seconds	60 seconds	90 seconds/ 4 minutes	60 seconds	60 seconds

Author, year	Civelek, 2012 [23]	Duger, 2012 [33]	Hashemi, 2014 [2]	Lakemeier, 2013 [24]
comparison	facet RFD vs. steroid injection			
intervention	NR (continuous)	pulsed RFD	pulsed RFD	NR (continuous)
temperature	80° C	40° C	<42° C	80° C
duration	120 seconds	6 minutes	120 seconds	90 seconds

Author, year	Kroll, 2008 [34]	Moon, 2013 [35]	Sanders, 1999 [36]
comparison	different RFD methods		
intervention	continuous RFD/pulsed RFD	NR (continuous)	NR (continuous)
temperature	80° C/42° C	80° C	NR
duration	75 seconds/120 seconds	90 seconds	60 seconds

Author, year	Cohen, 2008 [25]	Patel, 2012 [4]
comparison	SI RFD vs. placebo	
intervention	cooled RFD	cooled RFD
temperature	80° C	60° C
duration	90 seconds	150 seconds

SI sacroiliac, RFD radiofrequency denervation, NR not reported

Applicability of study results to the proposed clinical situation

Some of the study authors (e.g., [32]) clearly state that the careful patient selection is essential for the success of the intervention. Gallagher [31] reported back in 1994 that RFD should "be reserved for those reporting a clear temporary improvement from local anaesthetic" (based on the observation that 1/3 of the patients were not helped by facet joint injection). Based on available study results (and hypotheses from subgroup analyses), it could be possible to define further selection criteria in the future.

aufgrund der Beobachtungen von „Non-Respondern" wird sorgfältige PatientInnenselektion seit den 1990er Jahren diskutiert

Results from facet joint RFD studies cannot be adopted one-to-one to SI joint RFD. Facet joints are pairs of small joints that are situated at each vertebral level in the back of the spine. Sacroiliac joints are located in the pelvis (between the sacrum and ilium). Each facet joint is connected to two medial branch nerves that may carry pain signals to the brain, whereas lateral branch nerves carry (pain) signals from SI joints to the brain [9]. Therefore, two different types of RFD have to be distinguished: medial (facet joints) and lateral (sacroiliac joints) branch neurotomy. Lumbar facet joint innervation patterns are well-known, whereas the sensory innervation of the sacroiliac joint has not yet been as definitively defined. Variations of sensory innervation can occur [7]. To address this uncertainty, the cooled RFD technique aims at causing 'bigger' (and more) lesions[5] than used in conventional facet joint RFD.

Ergebnisse der Facettengelenks-RFD nicht 1:1 auf Iliosakralgelenks-RFD übertragbar (andere anatomische Gegebenheiten, andere RFD Technik)

Patients with joint pain due to acute trauma, fracture, malignancy, and inflammatory disease were excluded from this review. Therefore, no conclusions can be drawn on the effectiveness of RFD in these circumstances. An orienting search in PubMed (see Literature search strategies in the Appendix) for SI-RFD in patients with pseudoarthrosis, tumors/cancers, rheumatoid arthritis/spondyloarthropathies (as suggested as potential other indications by the submitting hospital) revealed 1 relevant trial (conducted in China, published in 2014) [38]. This RCT compared sacroiliac joint RFD (cooled RFD under CT-guidance) with a pharmaceutical therapy (celecoxib) in patients with ankylosing spondylitis (M. Bechterew; 82 vs. 73 patients). In an observation period of up to 24 weeks, they observed a significant pain reduction in favour of the RFD intervention and significant less epigastric pain, nausea, diarrhea (etc.) than with the nonsteroidal antirheumatic therapy. No severe adverse events were reported, but haemorrhages and infections occurred in 6% and 4% of RFD patients at the treatment site. At least based on this single trial result, it can be assumed that there might be selected patient populations which could benefit from the treatment in the future.

PatientInnen mit Schmerzen aufgrund von Tumoren, rheumatischen Erkrankungen etc. wurden in diesem Review nicht berücksichtigt; daher keine Aussagen über die Wirksamkeit möglich

orientierende Suche nach potentiell relevanten RCTs identifizierte eine Studie mit Iliosakral-RFD bei M. Bechterew PatientInnen

Evidence gaps

Neither for RFD in facet joints nor for RFD in sacroiliac joints, long-term data (>12 months) is available. Due to crossover, the situation is worst for RFD in SI joints, for which no group comparisons >3 months are available. Due to the natural course of the disease (chronic/recurrent) and the nature of the intervention (non-permanent due to the recovery of nerves) and the estimated high number of potentially benefitting patients (common disease), long-term data will be essential, not only to estimate the anticipated effect for single patients, but also to estimate the effect on the public health level. These data will not be obtained by placebo-controlled trials, as "doing noth-

Identifizierte Evidenzlücken:

v. a. keine Langzeitergebnisse verfügbar (für Iliosakralgelenke lediglich nur bis 3 Monate)

[5] Online information provided by the manufacturer: http://www.halyardhealth.com/solutions/pain-management/chronic-pain-solutions/sinergy.aspx

ing" will not be tolerated by pain-troubled patients. But as far as the superiority of RFD over the standard treatment (from conservative (steroid injections, analgetics, ...) to surgical (joint fusion) interventions) is not finally proven, (further or in case of the SI RFD new) direct comparisons will be needed.

Upcoming evidence

Ausblick: 3 der 4 laufenden RCTs zu Vergleichen

unterschiedlicher RFD Techniken

We identified 2 ongoing RCTs on lumbar facet joint pain comparing conventional and cooled RFD (NCT02478437) and RFD with 80 vs. 90° C (NCT-02148003) that will be completed Feb 2016-June 2017. The two 'ongoing' RCTs on sacroiliac joint pain (estimated completion date Dec. 2013-March 2015) compare RFD vs. a sham intervention (NCT01726608) and two different RFD methods (NCT02382289).

Limitations

mögliche Limitationen unserer Arbeit:
- ‚Vertrauen' in Literatursuche/ -auswahl der Cochrane Review AutorInnen (bis 2014)
- RCTs könnten in Sicherheitsfragen seltene Ereignisse übersehen
- z. T. fragwürdige Metaanalysen

We did not repeat the whole literature search and the selection process of the Cochrane Review. We therefore have to be confident that no relevant trial (up to 2014) had been missed.

In line with the Cochrane Review, we did not include other study designs than randomised controlled trials. Therefore, safety outcomes should be handled with care. Observational data might have added complications that cannot be observed in small RCTs.

Some of the meta-analyses (conducted by Cochrane Review's authors or based on own calculations) are insufficiently sound due to study dependencies, small number of studies, or even single studies. We aimed at providing them for the sake of completeness.

9 Recommendation

In Table 9-1 the scheme for recommendations is displayed and the according choice is highlighted.

Table 9-1: Evidence based recommendation:

	The **inclusion** in the catalogue of benefits is **recommended**.
	The **inclusion** in the catalogue of benefits is **recommended with restrictions**.
X	The inclusion in the catalogue of benefits is ***currently*** **not recommended.**
	The **inclusion in** the catalogue of benefits is **not recommended.**

Reasoning:

The current evidence is not sufficient to prove that the assessed technology, radiofrequency denervation [in adult patients with chronic (>3 months, facet or sacroiliac joint-) low back pain who had a positive response to diagnostic block], is more effective than, and as safe as, the comparator(s) (placebo/ sham intervention or conventional treatment). New study results will influence the effect estimate considerably.

The re-evaluation is recommended in 2019.

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Appendix

Evidence tables of individual studies included for clinical effectiveness and safety

Table A-1: Facet joint: Radiofrequency denervation vs. placebo treatment: Results from randomised controlled trials

Author, year	Gallagher, 1994 [31]	Leclaire, 2001 [32]	Nath, 2008 [30]	Tekin, 2007 [5]	Van Kleef, 1999 [6]	Van Wijk, 2005 [29]
Country	UK	Canada	Sweden	Turkey	Netherlands	Netherlands
Sponsor	NR	academic	no industry funding	NR	national funding	national funding
Study design	RCT	RCT	RCT	RCT	RCT	RCT
Number of pts	41 (24 vs. 17)	70 (36 vs. 34)	40 (20 vs. 20)	60 (20 vs. 20 vs. 20)	31 (15 vs. 16)	81 (40 vs. 41)
Intervention	Facet joint denervation: after anaestetizing the area with lignocaine 2% 0.5 mL, RF lesion was made at 80° C for 90 seconds group A: good response to diagnostic block + denervation (n=18) group B: equivocal response to diagnostic block + denervation (n=6)	Radiofrequency facet joint denervation at a minimum of 2 levels to medial branch of distal portion of spinal posterior rami nerve at 80° C for 90 seconds (n=36)	RF denervation of lumbar facet joint for 60 seconds at 85° C (n=20)	Conventional radiofrequency (CRF) denervation group: continuous RF lesions to medial branch at 80° C for 90 seconds at level L1 to L3 or L3 to L5 (n=20) Pulsed radiofrequency (PRF) denervation group: two Hertz PRF waves were applied for 4 minutes (45 V) at 42° C (n=20)	60-second radiofrequency lesion of 80° C of the medial branch of the posterior primary ramus of the segmental nerves L3-L5 on one or both sides (n=15)	60-second RF lesion at 80° C of dorsal ramus medial branches of relevant facet joints (n=40)
Comparator	Nerves to joints were identified by stimulation, local anaesthetic was injected in the usual way, but no heat lesion was made group C: good response to diagnostic block + placebo (n=12) group D: equivocal response to diagnostic block + placebo (n=5)	Same procedure as in experiment group, except that temperature of electrode tip was not raised but was maintained at 37° C (n=34)	Identical to intervention group, except no current was used and electrode tip remained at body temperature (n=20)	Control group (C): Electrodes and thermocouple probes were positioned similarly without switching on RF current; only bupivacaine 0.5% 0.3 mL was injected (n=20)	Identical procedure as in the intervention group, but without RF current (n=16)	Identical procedure as in the intervention group, without switching on RF current (n=41)

Author, year	Gallagher, 1994 [31]	Leclaire, 2001 [32]	Nath, 2008 [30]	Tekin, 2007 [5]	Van Kleef, 1999 [6]	Van Wijk, 2005 [29]
Inclusion criteria	25 to 55 years of age; back pain >3 months; ≥4 of the following symptoms: tenderness on palpation, more pain on extension than on flexion, pain on rotation of the spine, referred pain (above the knee), pain exacerbated by exercise and relieved by rest, pain exacerbated by sitting or standing, pain not exacerbated by coughing or sneezing, radiological evidence of facet joint degeneration or predisposing factors (such as loss of disc height or spondylolisthesis at the painful level)	18 to 65 years of age; low back pain >3 months; significant relief of low back pain for ≥24 hours during week after intraarticular facet injections under fluroscopy using Omnipaque	Adult participants; continuous low back pain ≥2 years; no response to previous treatment; ≥80% relief of pain following controlled medial branch blocks	>17 years of age; the following symptoms for >6 months: continuous low back pain with or without radiating into the upper leg, with focal tenderness over the facet joints, pain on hyperextension, no finding of obvious neurologic defect, no indication for low back surgery, no radicular syndrome, unresponsiveness to traditional conservative treatments; >50% pain relief on VAS to diagnostic medial branch block	20 to 60 years of age; chronic low back pain >12 months; initial mean VAS score >4 or VAS high score >7; conservative therapy attempted without success; absence of any neurological deficit by routine neurological examination; ≥50% pain relief after diagnotsic dorsal ramus nerve block with local anaesthetic solution	>17 years of age; continuous low back pain with or without radiating pain into the upper leg >6 months with focal tenderness over the facet joints; no radicular syndrome (i.e., no sensory or motor deficits, no positive straight leg raising test); no indication for low back surgery; ≥50% pain reduction on standard VAS applied 30 minutes after diagnostic block of lumbar facet joints
Exclusion criteria	Previous back operations; neurological signs of nerve root compression in the lower limbs; patients with major mental illness or severe personality disorder; pending compensation claims; general ill health	Allergy to local anaesthetic; blood coagulation disorder; cardiac pace-maker; sciatic pain with neurological deficit; low back pain not related to mechanical disorder; low back surgery; concomitant medical illness likely to compromise ability to participate	Pregnancy; coagulopathy; malignancy; infections; mental handicap; psychiatric disorder; motor deficit or any other indication for surgical treatment; patients who lived too far away to be able to participate	Prior RF treatment; coagulation disturbances; allergy to radiopaque contrast media or local anaesthetics; malignancy; mental handicap or psychiatric condition precluding adequate communication; language problems; pregnancy	Previous back surgery; known specific cause of low back pain (i.e., signs of herniation, spondylolisthesis, spondylosis ankylopoetica, spinal stenosis, extensive multilevel spondylosis, malignancy, infection, or trauma); diabetes mellitus, >1 pain syndrome	Prior RF treatment; coagulation disturbances; allergies for radiopaque contrast local anaesthetics; malignancy; mental handicap or psychiatric condition precluding adaequate communication; language problems; pregnancy
Mean age of patients, yrs (SD)	NR	46.7 (9.3) vs. 46.4 (9.8)	56 (range 36-79) vs. 53 (range 37-76)	60.5 (8.5) (CRF) vs. 59.6 (7.7) (PRF) vs. 57.9 (9.3) (C)	46.6 (7.4) vs. 41.4 (7.5)	46.9 (11.5) vs. 48.1 (12.6)
Sex (% female)	NR	66.7 vs. 61.8	70 vs. 55	55 (CRF) vs. 60 (PRF) vs. 55 (C)	66.7 vs. 62.5	75.0 vs. 68.3
Mean duration of symptoms, months (SD)	NR	NR	132 (range 24-324) vs. 144 (range 24-612)	37.5 (12.4) (CRF) vs. 35.1 (12.0) (PRF) vs. 32.8 (11.2) (C)	26 (range 12-120) vs. 48 (range 12-192)	duration of pain, %: ◦ ≤2 yrs: 22.5 vs. 22.0 ◦ 2-5 yrs: 25.0 vs. 29.3 ◦ ≥5 yrs: 52.5 vs. 48.8
Follow-up (months)	6	3	6	12	12	12
Loss to follow-up, n (%)	NR	1 (2.8) vs. 3 (8.8)	0 (0)	0 (0)	1 (3.1)	0 (0)

Author, year	Gallagher, 1994 [31]	Leclaire, 2001 [32]	Nath, 2008 [30]	Tekin, 2007 [5]	Van Kleef, 1999 [6]	Van Wijk, 2005 [29]
Outcomes						
Efficacy						
Pain intensity	Change in VAS score: • at 1 month: -17 (A) vs. +13 (B) vs. -13 (C) vs. -12 (D), **s. diff. between groups A and C** • at 6 months: -7 (A) vs. +5 (B) vs. -3 (C) vs. -17 (D), **s. diff. between groups A and C** Change in McGill Pain Questionnaire scores: • at 1 month: -3 (A) vs. +4 (B) vs. -2 (C) vs. -5 (D), **s. diff. between groups A and C** • at 6 months: 0 (A) vs. 0 (B) vs. -1 (C) vs. -3 (D)	Change in VAS score: • at 4 weeks: -3.6 vs. +0.6, n.s. • at 12 weeks: +0.5 vs. -7.2, n.s.	Change in VAS score: Back pain: • at 6 months: -2.1 vs. -0.7; n.s. Generalised pain: • at 6 months: -1.9 vs. -0.4, **s.s.**	Change in VAS score: • post procedure: -4.2 (CRF) vs. -3.8 (PRF) vs. -2.5 (C), **s. diff. between CRF/PRF groups and control group** • at 6 months: -4.2 (CRF) vs. -3.7 (PRF) vs. -3.7 (C), **s. diff. between CRF group and PRF/control groups** • at 12 months: -4.1 (CRF) vs. -3.1 (PRF) vs. -2.9 (C), **s. diff. between CRF group and PRF/control groups**	Change in VAS score: • at 8 weeks: -2.37 vs. -0.43, **s.s.**	Change in VAS score: Back pain: • at 3 months: -2.1 vs. -1.6, n.s.
Functional status	NR	Change in ODI score: • at 4 weeks: -2.7 vs. -2.1, n.s. • at 12 weeks: -4.7 vs. -2.7, n.s. Change in Roland-Morris Questionnaire (RMQ) score: • at 4 weeks: -8.4 vs. -2.2, n.s. (p=0.05) • at 12 weeks: -9.8 vs. -7.2, n.s.	NR[6]	Change in ODI score: • post procedure: -13.6 (CRF) vs. -15 (PRF) vs. -9.6 (C), **s. diff. between CRF/PRF groups and control group** • at 6 months: -14.1 (CRF) vs. –14.1 (PRF) vs. -11.2 (C), **s. diff. between CRF/PRF groups and control group** • at 12 months: -11.2 (CRF) vs. -10.9 (PRF) vs. -6.5 (C), **s. diff. between CRF/PRF groups and control group**	Change in ODI score: • at 8 weeks: -11.07 vs. +1.69, **s.s.** [7]: Change in COOP/WONCA chart • at 8 weeks: -3.13 vs. -1.62, n.s.	Mean change in physical activities: • at 3 months: +1.5 vs. +0.9, n.s.
Global improvement	NR	NR	Change in subjective global assessment (6-point scale): • at 6 months: -1.1 vs. -0.3, **s.s.**	NR	Change in global perceived effect[8]: • at 8 weeks: +1.33 vs. +0.37, **s.s.**	Change in global perceived effect on back pain, %: • at 3 months: ≥50% pain relief: 61.5 vs. 39.0, **s.s.**

[6] only specific variables for back movement and hip movement provided; no overall score

[7] Dartmouth COOP Functional Health Assessment Charts/World Organisation of Primary Care Physicians (WONCA)

[8] Global perceived effect was scored by the patient on a 7-point scale (ranging from much worse, -3; to 0, no change; to total pain relief, +3)

Author, year	Gallagher, 1994 [31]	Leclaire, 2001 [32]	Nath, 2008 [30]	Tekin, 2007 [5]	Van Kleef, 1999 [6]	Van Wijk, 2005 [29]
Health-related quality of life	NR	NR	NR[9]	NR	NR	s. diff. only in parameter "vitality" (no total score of SF-36 provided)
Ability to work	NR	NR	NR	NR	NR	NR
Satisfaction with treatment	NR	NR	NR	Patient satisfaction was lower in control group than other groups, and highest in CRF group (**s.s.**)	NR	NR
Safety						
Complications	no adverse effects no evidence of any nerve root anaesthesia or damage	no complications	no complications	no complications	no complications	no significant differences in occurrence of treatment-related pain and subjective sensory or motor changes

Abbreviations: NR not reported; n.s. not significant; ODI Oswestry Disability Index; RF radiofrequency; s.s. statistically significant; VAS visual analogue scale; yrs years; CRF conventional RFD, PRF pulsed RFD

[9] various quality of life variables provided, but no overall score

Table A-2: Facet joint: Radiofrequency denervation vs. steroid injection: Results from randomised controlled trials

Author, year	Civelek, 2012 [23]	Duger, 2012 [33]	Hashemi, 2014 [2]	Lakemeier, 2013 [24]
Country	Turkey	Turkey	Iran	Germany
Sponsor	NR	NR	NR	no funding
Study design	RCT	RCT	RCT	RCT
Number of pts	100 (50 vs. 50)	120 (40 vs. 40 vs. 40)	80 (40 vs. 40)	56 (27 vs. 29)
Intervention	Facet joint radiofrequency (FJRF) denervation at 80°C for 120 seconds (n=50)	RF denervation group (group R): localisation of RF electrode in the facet joint causing pain was determined by sensorial stimulus and C-armed scope device. Pulsed RF thermocoagulation for 6 minutes at 40°C with RF lesion generator (n=40)	Pulsed radiofrequency (n=40)	Radiofrequency denervation: curved RF needles with 100-mm active tips were placed at the site of the dorsal ramus medial branch of the relevant L3/L4-L5/S1 LFJs, 1mL of 0.5% bupivacaine was injected, the RF probe was then inserted into the cannula and lesion at a temperature of 80° C for 90 seconds using an RF generator (n=27)
Comparator	Facet joint injection (FJI) with medial branch block of posterior primary ramus with 1 cc of methylprednisolone acetate (40 mg) (diluted with 1 cc SF) combined with 2 cc bupivacaine hydrochloride (diluted with 2 cc SF) (n=50)	Injection group (group B): after C-arm scope guided determination of injection point, injection of 1.5mL of 20mg methyl-prednisolone acetate mixed with 5mg bupivacaine into the facet joint (n=40) RF denervation and injection group (group RB): localisation of RF electrode in the facet joint causing pain was determined by sensorial stimulus and C-armed scope device. Pulsed RF thermo-coagulation for 6 minutes at 40°C and injection of 1.5 ml mixture of 20 mg methylprednisolone acetate and 5 mg bupivacaine at the same localization (n=40)	Injection by steroids (1 mL (40mg) triamcinolone) and 0.5mL bupivacaine 0.5% (n=40)	Intraarticular injection of steroids: same setting was used for LJF infiltrations and RF denervation; the RF probe was inserted into the cannula and the denervation process (80° C for 90 seconds) was begun, but the electrodes were not connected to the pain generator device (n=29)
Inclusion criteria	Chronic and debilitating low back pain leading to diagnosis of lumbar facet syndrome; not responding to conservative treatment for up to 6 weeks, including various analgesics and physical therapy and additional pain relief after FJI for participants with FJRF; symptoms of facet syn-drome include local tenderness over 1 or more FJs, back pain aggravated by hyperextension and rotation, morning stiffness or pain increasing in the morning and hip and buttock pain of a non-radicular distribution	18 to 60 years of age; single-sided low back pain arising from facet joint; complaints longer than 6 months, limited functions and daily life; presented with at least 2 of the 4 symptoms of facet syndrome (back pain aggravation by hyperextension and rotation, morning stiffness or pain increasing in the morning, local tenderness over one or more facet joints and hip and buttock pain of a nonradicular distribution)	>18 years of age; spondylolisthesis grade I in MRI at 1 single level (2 adjacent vertebrae and 1 disc); chronic low back pain >6 months; supra-vertebral facet tenderness; pain in hyperextension; minimum NRS score of 4 (moderate to severe pain) and positive diagnostic medial branch block test	≥18 years of age; lumbar facet joint (LFJ)-related low back pain ≥24 months; ability to understand study protocol and to provide voluntary written informed consent and participate in outcome measurements; a benefit in pain reduction ≥50% after test injection of local anaesthetics into the L3/L4-L5/S1 LFJ; MRI-proven LFJ osteoarthritis and hypertrophy in the L3/L4-L5/S1 segments

Author, year	Civelek, 2012 [23]	Duger, 2012 [33]	Hashemi, 2014 [2]	Lakemeier, 2013 [24]
Exclusion criteria	Radicular pain, neurogenic claudication and neurological deficits; acute or uncontrolled medical illness; known history of adverse reactions to local anaesthetics, pregnancy or lactation	Coagulation defect, major depression and uncontrolled psychiatric disorder, pregnancy or lactation, respiratory or cardiac problems in prone position, opioid treatment during the previous month, undergoing surgical procedure at the same site, infection at the procedure site, disc-related radicular symptoms; patients not accepting the procedure and not giving informed consent	Radicular pain; neurologic deficit; indication for surgery (neurologic deficit and urinary inconsistent); stenosis of the spinal canal; spondylolysis; positive straight leg raising test; suppressed reflex; known psychiatric disease; spinal deformity; neoplastic or infectious disease	Lack of positive response to L3/L4-L5/S1 test infiltration; history of osteoporosis or malignancies; allergies to local anaesthetics; pregnancy or lactation; lumbar spinal stenosis or spinal instability; vertebral fracture; symptomatic radiculopathy; uncontrolled psychiatric disorder; uncontrolled medical illness; condition that could interfere with interpretation of outcome assessments; history of adverse reactions to corticosteroids
Mean age of patients, yrs (SD)	51.8 (17.0) vs. 56.5 (17.7)	50.2 (12.1) (R) vs. 50.1 (12.3) (B) vs. 51.2 (11.9) (RB)	64.3 (13.3) vs. 63.9 (11.5)	57.6 (12.8) vs. 56.3 (10.8)
Sex (% female)	70.0 vs. 70.8	53.3 (R) vs. 56.7 (B) vs. 56.7 (RB)[a]	52.5 vs. 55.0	34.6 vs. 38.5
Mean duration of symptoms, months (SD)	18.9 (12.9) vs. 18.7 (12.3)	10.7 (5.2) (R) vs. 11.3 (5.1) (B) vs. 11.0 (5.0) (RB)	3.4 (2.3) vs. 3.8 (2.5)	NR
Follow-up (months)	12	12	6	6
Loss to follow-up, n (%)	0 (0)	NR	1 (2.5) vs. 1 (2.5)	1 (4) vs. 3 (10)
Outcomes				
Efficacy				
Pain intensity	Change in VNS score: • at 1 month: -6.0 vs. -5.1, **s.s** • at 6 months: -5.7 vs. -4.1, **s.s.** • at 12 months: -5.6 vs. -3.6, **s.s.**	Change in VAS score: • at 1 month: -4.3 (R) vs. -1.7 (B) vs. -4.2 (RB), **s. diff. btw. R and B, and btw. RB and B** • at 6 months: -4.2 (R) vs. -0.6 (B) vs. -4.3 (RB), **s. diff. btw. R and B, and btw. RB and B** • at 12 months: -3.3 (R) vs. -0.1 (B) vs. -3.4 (RB), **s. diff. btw. R and B, and btw. RB and B**	Change in NRS score: • at 6 months: -5 (PRF group), **s. diff. between PRF and steroid group at 12 weeks and 6 months**, n.s. at 6 weeks	Change in VAS score: • at 6 months: -1.9 vs. -1.6, n.s.
Functional status	NR	NR	Change in ODI score: • at 6 months: -56.3% (PRF group), **s. diff. between PRF and steroid group at 12 weeks and 6 months**, n.s. at 6 weeks	Change in ODI score: • at 6 months: -12.8 vs. -5.7, n.s. Change in RMQ score: • at 6 months: -3.7 vs. -4.2, n.s.
Global improvement	NR	NR	NR	NR
Health-related quality of life	Change in EQ-5D score: • at 1 month: -8.2 vs. -8.7, n.s. • at 6 months: -7.3 vs. -7.5, n.s. • at 12 months: -7.1 vs. -6.7, n.s.	NR	NR	NR

Author, year	Civelek, 2012 [23]	Duger, 2012 [33]	Hashemi, 2014 [2]	Lakemeier, 2013 [24]
Ability to work	NR	NR	NR	NR
Satisfaction with treatment	There was no significant difference in the 1st and 6th month follow-ups, however there was a significant difference respect to 12 month NASS patients' satisfaction scores[10]	All the values except those obtained at day 2 and week 1 were higher in group R when compared to group B; in group RB, early satisfaction values (day 1, day 2, week 1) were higher compared to group R; in group RB, all satisfaction values except at day 2 and week 1 were higher compared to group B	Patient satisfaction was significantly higher in PRF group at 12 weeks and 6 months compared to steroid group	NR
Safety				
Complications	no infections or new motor or sensory deficits rare complaints of small superficial burns after RFD increase in severity of low back pain in 2 RFD pts (4%) in the early follow-up period	no complications	NR	no major adverse events

Abbreviations: FJI Facet joint injection, FJRF Facet joint radiofrequency, NASS North American Spine Society patient satisfaction questionnaire; NRS numeric rating scale; NR not reported; n.s. not significant; ODI Oswestry Disability Index; RF radiofrequency; RMQ Roland-Morris Questionnaire; s.s. statistically significant; VAS visual analogue scale; VNS visual numeric pain scale; yrs years

[a] *instead of 40 pts per group only 30 each are described in the demographic data table. An email request to the author (8.2.2016) remained without reply.*

Table A-3: Facet joint: Radiofrequency denervation vs. other treatment (other RFD method): Results from randomised controlled trials

Author, year	Kroll, 2008 [34]	Moon, 2013 [35]	Sanders, 1999 [36]
Country	USA	Korea	Netherlands
Sponsor	NR	no industry funding	NR
Study design	RCT	RCT	RCT
Number of pts	26 (13 vs. 13)	82 (41 vs. 41)	34 (17 vs. 17)
Intervention	Continuous RF group (CRF): continuous RF thermocoagulation lesioning performed at 80° C for 75 seconds (n=13)	Distal approach group (D): fluoroscopic distal approach was used for L1 to L4 medial branches (n=41)	Percutaneous intra-articular facet denervation (PIFD): after injection of 1ml lidocaine 2%, 3 RF lesions (60 seconds) were made in the articular cavity, central, rostral, and caudal of the facet joint (n=17)

[10] NASS Score: 1=fully meeting of patient's expectations, 2=less improvement than the hoped for result but the patient would undergo the same procedure again, 3=the procedure helped but the patient would not undergo again, 4=the same or worse status with respect to pre-operative status

Author, year	Kroll, 2008 [34]	Moon, 2013 [35]	Sanders, 1999 [36]
Comparator	Pulsed RF group (PRF): pulsed RF lesioning at 42° with pulse duration of 20 ms and pulse rate of 2 Hz for 120 seconds (n=13)	Tunnel vision approach group (TV): lumbar medial branch radiofrequency denervation was performed under fluoroscopic guidance in an oblique "tunneled" view, as described by Bogduk 2005 (n=41)	Extra-articular facet denervation (PEFD) following the method described by Mehta and Sluijter (n=17)
Inclusion criteria	≥18 years of age; ASA[11] physical status I, II and III; unilateral or bilateral lumbar back pain for longer than 1 month; no radiating symptoms below the knee; >50% pain reduction based on mean VAS after 2 separate diagnostic medial branch blocks with 1.0mL of 0.5% bupivacaine	>18 years of age; predominantly axial lower back pain for ≥3 months; paraspinal tenderness overlying the L2 to L4 lumbar facet joints; failure to respond to conservative therapy such as physical therapy or pharmacotherapy; concordant pain relief of >50% after a comparative local anaesthetic block with 0.5mL lidocaine 1% (≥1 hour) and levobupivacaine hydrochloride 0.5% (≥3 hours) at the L1 to L4 medial branches	Low back pain >6 months; pain exacerbated by extension of the lumbar spine, prolonged standing or sitting; deep pressure pain over the lumbar facet joints and absence of neurological abnormalities; no improvement from physical therapy; pain intensity on VAS >4; ≥50% pain relief after diagnostic block
Exclusion criteria	History of previous back surgery; presence of neurological deficits; claudication; active psychiatric disorder; bleeding disorder; active infection; pregnancy; involved in current litigation; ongoing workers' compensation claims; disc herniation and spinal stenosis (ruled out radiographically)	Any focal neurological signs or symptoms; radiologic evidence of a symptomatic herniated disc; severe spinal stenosis or structural lumbar spinal deformity; a positive response to previous spinal interventions such as sacroiliac joint block or epidural steroid injection; discogenic pain verified by discography; lumbar spine fusion; untreated coagulopathy; concomitant medical or psychiatric condition likely to undermine diagnostic workup or assessment of treatment response	Radicular pain (neurological signs of nerve root compression); previous back operation(s); age <18 years; bleeding disorders; presence of prominent functional or non-physiological signs
Mean age of patients, yrs (SD)	59.5 (11.6) (CRF) vs. 57.0 (8.4) (PRF)	68.6 (13.8) (D) vs. 62.6 (14.5) (TV)	60.9 (18.5) vs. 62.6 (14.6)
Sex (% female)	46.1 (CRF) vs. 61.5 (PRF)	61.8 (D) vs. 70,6 (TV)	23.5 vs. 29.4
Mean duration of symptoms, months (SD)	NR	40.8 (40.6) (D) vs. 29.3 (23.9) (TV)	NR
Follow-up (months)	3	6	3
Loss to follow-up, n (%)	12 (48) vs. 12 (48)	5 (12.2) (D) vs. 6 (14.6) (TV)[12]	NR
Outcomes			
Safety			
Complications	No adverse events were encountered during CRF or PRF lesioning, and no complications were documented 3 months post-procedure	RF-associated complication during the 6-month follow-up: 1 (D) vs. 5 (TV) (mild, localized pain at the RF lesion site lasting <1 month (1 vs 2); new neuropathy-like pain lasting >3 months (0 vs 3))	No complications or morbidity were observed

Abbreviations: FJI Facet joint injection, FJRF Facet joint radiofrequency, NASS North American Spine Society patient satisfaction questionnaire; NRS numeric rating scale; NR not reported; n.s. not significant; ODI Oswestry Disability Index; RF radiofrequency; RMQ Roland-Morris Questionnaire; s.s. statistically significant; VAS visual analogue scale; VNS visual numeric pain scale; yrs years

[11] is a five-category physical status classification system adopted by the American Society of Anesthesiologists (ASA) for assessing the fitness of patients before surgery: I = healthy person; II = mild systemic disease; III = severe systemic disease

[12] Additionally, 3 patients (1 in the tunnel vision approach group and 2 in the distal approach group) were excluded because of failure in both motor and sensory stimulation at 2 or more nerves.

Table A-4: Sacroiliac joint Radiofrequency denervation vs. placebo: Results from randomised controlled trials

Author, year	Cohen, 2008 [25]	Patel, 2012 [4]
Country	USA	USA
Sponsor	academic/Baylis Medical	Baylis Medical
Study design	RCT	RCT
Number of pts	28 (14 vs. 14)	51 (34 vs. 17)
Intervention	Cooled RF denervation group received L4-L5 primary dorsal rami and S1-S3 lateral branch RF denervation (80°C, 90 seconds) using cooling probe technology after local anaesthetic block (n=14)	RF energy was delivered for 150 seconds at set temperature of 60°C; first L5 dorsal ramus was lesioned; after coagulation of L5 dorsal ramus, sacral lateral branches of S1, S2 and S3 were targeted (n=34)
Comparator	Control group received local anaesthetic block followed by placebo denervation, in which 0.5 ml lidocaine 2% was administered with no current (n=14) Participants who did not respond to placebo injections crossed over and were treated with RF denervation using conventional technology (n=11)	Same procedure as in experimental group, except that RF energy was not delivered. Probe placements, procedure duration, equipment sounds and visual indications for participants were identical in both groups (n=17)
Inclusion criteria	>18 years of age; axial low back or buttock pain ≥ 6 months; tenderness overlying SI joint(s); failure to respond to conservative therapy (e.g., physical therapy and pharmacotherapy); long-term (>2 months) pain relief with SI joint corticosteroid injections; pain relief ≥ 75% as calculated from a 6-hour post-block pain diary after a single diagnostic SI joint injection	>18 years of age; predominantly axial pain below L5 vertebrae; axial pain lasting longer than 6 months; three-day average NRS between 4 and 8; failure to achieve adequate improvement with comprehensive non-operative treatments, including but not limited to activity alteration, non-steroidal antiinflammatory drugs, physical and/or manual therapy and fluoro-scopically guided injections of steroids into SIJ or sacroiliac ligaments; other possible sources of low back pain reasonably excluded (by means of physical exam, medical history and magnetic resonance imaging/computed tomography/X-ray as required), including but not limited to bone fracture, hip joint, symptomatic spondylolisthesis, tumour and other regional soft tissue structures
Exclusion criteria	Focal neurological signs or symptoms; radiological evidence of symptomatic herniated disc; spondyloarthropathy; untreated coagulopathy; unstable medical or psychiatric illness that might preclude an optimal treatment response	Beck Depression Inventory score >20; irreversible psychological barriers to recovery; spinal pathology that may impede recovery, such as spondylolisthesis at L5/S1, or scoliosis; symptomatic moderate or severe foraminal or central canal stenosis; systemic infection or localised infection at anticipated introducer entry site; concomitant cervical or thoracic pain >2/10 on a NRS scale; uncontrolled or acute illness; chronic severe conditions such as rheumatoid/inflammatory arthritis; pregnancy; active radicular pain; immunosuppression (e.g. AIDS, cancer, diabetes, surgery < 3 months before); workers' compensation, injury litigation or disability remuneration; allergy to injectate or medications used during procedure; high narcotics usage (> 30 mg morphine daily or equivalent); active smokers (termination ≥ 6 months with no smoking during follow-up period acceptable with caution);); history of potentially confounding intervertebral disc disease or zygapophyseal joint pain
Mean age of patients, yrs (SD)	51.9 (13.6) vs. 51.8 (13.1)	56 (15) vs. 64 (14)
Sex (% female)	64 vs. 57	68 vs. 82

Author, year	Cohen, 2008 [25]	Patel, 2012 [4]
Mean duration of symptoms	NR	6-12 months: 18% vs. 6% 12-24 months: 15% vs. 18% >24 months: 65% vs. 77%
Follow-up (months)	6 (crossover of control group patients after 1 or 3 months)	9 resp. 12 [3] (but crossover of control group patients after 3 months)
Loss to follow-up, n (%)	0 (0)	0 (0) at 3 months
Outcomes		
Efficacy		
Pain intensity	Change in NRS scores: • at 1 month: -3.7 vs. -0.2, **s.s.** • at 3 months: -3.7 vs. -0.5[13]	Change in NRS scores: • at 1 month: -2.7 vs. -1.7, n.s. • at 3 months: -2.4 vs. -0.8, **s.s.**
Functional status	Change in ODI scores: • at 1 month: -16.2 vs. -4.3, **s.s.** • at 3 months: -18.6 vs. -23.9[13]	Change in ODI scores: • at 1 month: -12 vs. -4, **s.s.** • at 3 months: -11 vs. +2, **s.s.**
Global improvement	Positive GPE[14], % (95% CI): • at 1 month: 93 (78-100) vs. 21 (2-45), **s.s.** • at 3 months: 83 (59-100) vs. 0[13]	Positive GPE[15], % (95% CI): • at 3 months: 47 (29-65) vs. 8 (0-36), **s.s.**
Health-related quality of life	NR	Change in AQoL scores: • at 1 month: +0.07 vs. +0.07, n.s. • at 3 months:+0.09 vs. +0.02, **s.s.**
Ability to work	NR	NR
Satisfaction with treatment	NR	NR
Safety		
Complications	no serious complications (both groups) majority of patients: temporary worsening pain (lasting 5-10 days after the procedure) one RFD patient (1/25 (4%) due to crossover) reported transient nonpainful buttock paresthesia that resolved without therapy	no serious complications (both groups) small proportion of subjects: soreness or numbness at the introducer sites in the 2 weeks following treatment one subject: shingles at the introducer site (deemed unrelated to treatment)

Abbreviations: AQoL Assessment of Quality of Life; GPE Global Perceived Effect; NR not reported; NRS numerical rating pain scale; n.s. not significant; ODI Oswestry Disability Index; RF radiofrequency; s.s. statistically significant; VAS visual analogue scale; yrs years

[13] Due to crossover of control group, 3-months results are based on only 2 patients in the original placebo group

[14] A positive GPE was defined as an affirmative response to the following 3 questions: 1. My pain has improved/worsened/stayed the same since my last visit; 2. The treatment I received improved/did not improve my ability to perform daily activities; 3. I am satisfied/not satisfied with the treatment I received and would recommend it to others.

[15] GPE was measured by having subjects rate their index pain on a 7-item scale; a GPE score was considered positive if the subject rated GPE as „pain has decreased a lot“ or „pain is completely gone“

Risk of bias table

The risk of bias of included studies was assessed by the Cochrane Risk of Bias tool and judged by two researchers. A more detailed description of the criteria used to assess the internal validity of the individual study designs can be found in the Cochrane Handbook for Systematic Reviews of Interventions [39].

Table A-5: Risk of bias – study level (randomised studies)

Trial	Adequate generation of randomisation sequence	Adequate allocation concealment	Blinding		Selective outcome reporting unlikely*	No other aspects which increase the risk of bias	Risk of bias – study level
			Patient	Treating Physician/ follow up examination			
RFA in fact joints vs. placebo							
Gallagher, 1994 [31]	unclear	unclear	yes	unclear/yes	unclear	no[a]	high
Leclaire, 2001 [32]	yes	yes	yes	unclear/yes	unclear	yes	low
Nath, 2008 [30]	yes	yes	yes	yes/yes	unclear	no[b]	high
Tekin, 2007 [5]	yes	yes	yes	unclear/yes	unclear	yes	low
Van Kleef, 1999 [6]	yes	yes	yes	yes/yes	unclear	yes	low
Van Wijk, 2005 [29]	yes	yes	yes	yes/yes	unclear	yes	low
RFA in fact joints vs injection therapy							
Civelek, 2012 [23]	yes	unclear	unclear	no/yes	unclear	yes	high
Duger, 2012 [33]	unclear	unclear	unclear	no/unclear	unclear	no[a]	high
Hashemi, 2014 [2]	yes	unclear	no	no/yes	unclear	yes	high
Lakemeier, 2013 [24]	yes	yes	yes	no/yes	unclear	yes	low
RFA in SI joints							
Cohen, 2008 [25]	yes	yes	yes	unclear/yes	yes	no[b]	high
Patel, 2012 [4]	yes	yes	yes	no/yes	yes	yes	low
RFA in fact joints vs. other method of RFA (for safety only)							
Kroll, 2008 [34]	yes	unclear	unclear	unclear	unclear	no[c]	high
Moon, 2013 [35]	unclear	unclear	unclear	unclear/unclear	yes	yes	high
Sanders, 1999 [36]	unclear	unclear	unclear	unclear/unclear	unclear	no[a]	high

**This risk was defined as unclear if author's didn't explicitly state that a protocol was published before/the study was not registered;*
[a] *number of drop-outs unclear;* [b] *baseline characteristics not similar;* [c] *high number of drop-outs*

Applicability tables

Table A-6a: Summary table characterising the applicability of a body of studies (RFD for facet joint pain)

Domain	Description of applicability of evidence
Population	The patient population (n=679) differed considerably between studies. Patients had suffered from back pain for more than 3 months up to at least 2 years. The mean age of included patients ranged from 41 to 64 years. The percentage of female participants was more than half of the patients in all, but one trial.
Intervention	The RCTs on RFD for facet joint pain applied continuous or pulsed RFD methods (40-85° C, 60-120s). The optimal "dose" of RFD seems to be still under examination.
Comparators	6 trials compared radiofrequency denervation with a placebo/sham treatment, the remaining 4 studies used steroid injections as comparator.
Outcomes	All outcomes defined as crucial for the decision were reported in the included trials: All trials reported pain outcomes (generally measured by the VAS), half of the trials changes in functional status mesured by the ODI. 3 trials reported 'global impovements' and only 2 assed (generic) health-related quality of life. 9 of 10 studies mentioned (at least the non-occurance of) complications, but there seemed to be no standardised assessment/documentation. Of the important (not crucial) outcomes, 4 studies reported on patient satisfaction, non on the ability to work. There are no data on outcomes at >12 months after intervention.
Setting	3 trials were conducted in Turkey, 2 in the Netherlands, the remaining 5 studies in Canada, Germany, Iran, Sweden, and the UK. The steroid injection compared trials were conducted more recently (published between 2012 and 2014) than the placebo-controlled trials (1994-2008).

Table A-6b: Summary table characterising the applicability of a body of studies (RFD for sacroiliac joint pain)

Domain	Description of applicability of evidence
Population	The total number of patients was 79. Patients had suffered from low back pain for more than 6 months and had not achieved adequate improvement after conservative therapies. The mean age of patients was 52-64 years. 57-82% of the patients were female.
Intervention	Both RCTs used a "cooled radiofrequency denervation" method (with temperatures from 60 to 80°C and durations from 90 to 150 seconds). The optimal "dose" of RFD seems to be still under examination.
Comparators	Both RCTs compared radiofrequency denervation with placebo/sham treatment.
Outcomes	All outcomes defined as crucial for the decision were reported in the included trials: Both trials reported pain outcomes (measured by the NRS scores) and changes in functional status mesured by the ODI. Both trials also reported the 'global impovement' (determined by the same instrument (GPE). Only 1 trial asked (generic) health-related quality of life. Both studies described complications (in more detail than the facet joint pain studies). None of the studies provided data on the outcomes defined as important (not crucial: patient satisfaction, the ability to work). There are no data on outcomes at >3 month after intervention.
Setting	On the contrary to the above mentioned trials on RFD for facet joint pain (no north American study), both trials on sacroiliac joint pain were conducted in the US (and published 2008-2012).

List of ongoing randomised controlled trials

Table A-7: List of ongoing randomised controlled trials of RFD for facet joint pain

Identifier/ Trial name	Patient population	Intervention	Comparison	Primary Outcome	Primary completion date	Sponsor
NCT02478437 A Trial of Cooled Radiofrequency Ablation of Medial Branch Nerves for the Treatment of Lumbar Facet Syndrome	18-79 years of age, lumbar facet syndrome pain, low back pain >6 months, pain resistant to conventional therapy, pain diagram suggesting possibility of facet-mediated pain, positive response to at least 1 set of diagnostic intra-articular facet injections or medial branch blocks	Conventional radio-frequency ablation (RFA)	Cooled radio-frequency ablation (CRFA)	Pain improvement, global pain score, McGill Pain Questionnaire (MPQ), Pain Anxiety Symptom Scale short form (PASS-20), Center for Epidemiologic Studies Depression short form index (CESD-10)	June 2017	North-western University, American Pain Society
NCT02148003 Effect of the Temperature Used in Thermal Radiofrequency Ablation	>18 years of age, low back pain, chronic back pain attributed to lumbar facet joints arthropathy, adequate response to the diagnostic blocks without the use of steroids	Radio-frequency ablation (performed at 90 degrees Celsius)	Radio-frequency ablation (performed at 80 degrees Celsius)	Assessing a change of pain relief, number of repeats of procedure	February 2016	The Cleveland Clinic

Table A-8: List of ongoing randomised controlled trials of RFD for sacroiliac pain

Identifier/ Trial name	Patient population	Intervention	Comparison	Primary Outcome	Primary completion date	Sponsor
NCT02382289 Radiofrequency in Sacroiliac Arthropathy; Bipolar RF 6 Points Versus Monopolar RF at 6 and 3 Points	>18 years, chronic sacroiliac joint arthropathy; moderate to severe low back pain for >6 months with positive Patrick's and Yeoman's tests with tenderness over the SI joint. Pain is not responding to the usual medical treatment. >50% pain relief after diagnostic injection with local anesthetic.	Procedure: radio-frequency ablation for sacroiliac joint arthropathy	Comparing bipolar RF at 6 points with monopolar RF at 3 and 6 points for the treatment of SI arthropathy	Patient satisfaction	March 2015	King Hamad University Hospital, Bahrain
NCT01726608 RFN for SIJ Disease Study[16]	18-80 years of age, low back pain >6 months duration, >80% reduction in pain following each diagnostic, intra-articular block.	Active radio-frequency neurotomy	Sham radio-frequency neurotomy	Pain intensity, quality of pain, health related quality of life, anxiety and depression, functional disability, health related quality of life and quality-adjusted life years, portion of patients randomised to sham requiring rescue therapy with RFN	December 2013	Barts & The London NHS Trust

[16] Due to the provided study completion date (2013), we contacted the principal investigator (V. Metha) on Feb 28th, but received no answer so far.

Additional information:
List of (registered) completed but unpublished or terminated randomised controlled trials

Table A-9a: List of completed but unpublished randomised controlled trials (RFD for facet joint pain)

Identifier/ Trial name	Patient population	Intervention	Comparison	Primary Outcome	Primary completion date	Sponsor
NCT00476684 The Effect of Radiofrequency-treatment on Patients With Facet-joint Pain in Cervical- and Lumbar-columna[17]	20-75 years of age, one-sided neck and low back chronic pain, pain durability of at least 1 year	Radio-frequency treatment	Sham neurotomy	Reduction in self-reported pain intensity	May 2010	Norwegian University of Science and Technology
NCT00484159[18] Efficacy and Cost: Benefit Ratio of 0, 1, and 2 Medial Branch Blocks for Lumbar Facet Joint Radiofrequency Denervation	>18 years of age, axial low back pain unresponsive to conservative treatment, duration of pain >6 months	Radio-frequency denervation of medial branches that innervate the lumbar facet joints	Comparison of 3 different RFD groups	Cost per successful procedure, successful treatment	January 2009	Johns Hopkins University

Table A-9b: List of terminated randomised controlled trials (RFD for sacroiliac pain)

Identifier/ Trial name	Patient population	Intervention	Comparison	Primary Outcome	Primary completion date	Sponsor
NCT01158092[19] Trial Comparing Treatment With SInergy™ System to Conservative Treatment for Chronic Sacroiliac Joint Pain	>18 years of age, predominantly axial pain below the L5 vertebrae >75% pain relief from 2 separate lateral branch blocks done on different days, chronic axial pain lasting >six months, no improvement with comprehensive non-operative treatments	Lateral branch denervation using the SInergy™ System (cooled RFD)	Conservative Treatment: physical therapy, chiropractic care, and medication	Pain status change for sacroiliac region, change in bodily pain and physical functioning evaluated using SF-36, change in disability evaluated using Oswestry Disability Index, change in quality of life	March 2012	Baylis Medical Company

[17] *A web search revealed the information that study data has not been published yet. Principal investigator (P. Borchgrevink) was contacted on Feb 28th, but no answer was received*

[18] *Basic Results are already provided at clinicaltrials.gov. Principal investigator (S.Cohen) contacted on Feb 28th; his answer: "This study has enrolled 160 out of 225 patients. It is still ongoing and nothing has been published yet."*

[19] *This study has been terminated. E. Ross (principal investigator) contacted 28.2.2016, his answer: "I believe funding was stopped by the sponsoring company"*

Literature search strategies

Search strategy for MEDLINE

Search Name: **Update search (of Cochrane Review) explicitly including the sacroiliac joint** Database: Ovid MEDLINE(R) <1946 to November Week 3 2015>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <December 28, 2015>, Ovid MEDLINE(R) Daily Update <November 18, 2015>, Ovid OLDMEDLINE(R) <1946 to 1965>	
Search Date: 09.12.2015	
ID	Search
#1	1 ((randomized controlled trial or controlled clinical trial).pt. or randomi#ed.ab. or placebo.ab,ti. or drug therapy.fs. or randomly.ab,ti. or trial.ab,ti. or groups.ab,ti.) not (animals not (humans and animals)).sh. (3275407)
#2	dorsalgia.ti,ab. or exp Back Pain/or backache.ti,ab. or (lumbar adj pain).ti,ab. or coccyx.ti,ab. or coccydynia.ti,ab. or sciatica.ti,ab. or sciatic neuropathy/or spondylosis.ti,ab. or lumbago.ti,ab. (41368)
#3	exp Spine/or discitis.ti,ab. or exp Spinal Diseases/or (disc adj degeneration).ti,ab. or (disc adj prolapse).ti,ab. or (disc adj herniation).ti,ab. or spinal fusion.sh. or (facet adj joints).ti,ab. or intervertebral disc.sh. or postlaminectomy.ti,ab. or arachnoiditis.ti,ab. or (failed adj back).ti,ab. (179612)
4	2 or 3 (205558)
5	exp Radio Waves/or exp Pulsed Radiofrequency Treatment/or radiofrequency.mp. or radio frequency.mp. or exp Electrocoagulation/or electrocoag$.mp. or thermocoag$.mp. or (neurotom$ or neuroly$).mp. (73259)
6	1 and 4 and 5 (235)
7	exp Sacroiliac Joint/(3419)
8	sacroiliac joint*.mp. (4726)
9	sacro-iliac joint*.mp. (283)
10	7 or 8 or 9 (4842)
11	4 or 10 (207914)
12	1 and 5 and 11 (243)
13	12 not 6 (8)
Total: 8 Hits	

Additional information: Search strategy for PubMed

Search Name: **Radiofrequenc Denervation for sacroiliac joint pain due to "other indications"**
Search Date: 04.02.2016
((Sacroiliac Joint[MeSH] OR sacroiliac joint* OR sacro-iliac joint*) AND (Pseudarthrosis[MeSH] OR pseudarthros* OR pseudoarthros* OR pseudo-arthros* OR Arthrodesis[MeSH] OR arthrodes* OR tumor* OR tumour*OR cancer* OR neoplasm* OR carcinoma* OR Carcinoma[MeSH] OR Neoplasms[MeSH] OR Arthritis, Rheumatoid[MeSH] OR rheumatoid OR Spondylarthropathies[MeSH] OR Spondylarthropath*) AND (Denervation[MeSH] OR denervation* OR de-nervation* OR Radio Waves[MeSH] OR Pulsed Radiofrequency Treatment[MeSH] OR radiofrequency OR radio-frequency OR Electrocoagulation[MeSH] OR electrocoag* OR thermocoag* OR neurotom* OR neuroly*))
Total: 4 Hits