Hes·so VALAIS WALLIS
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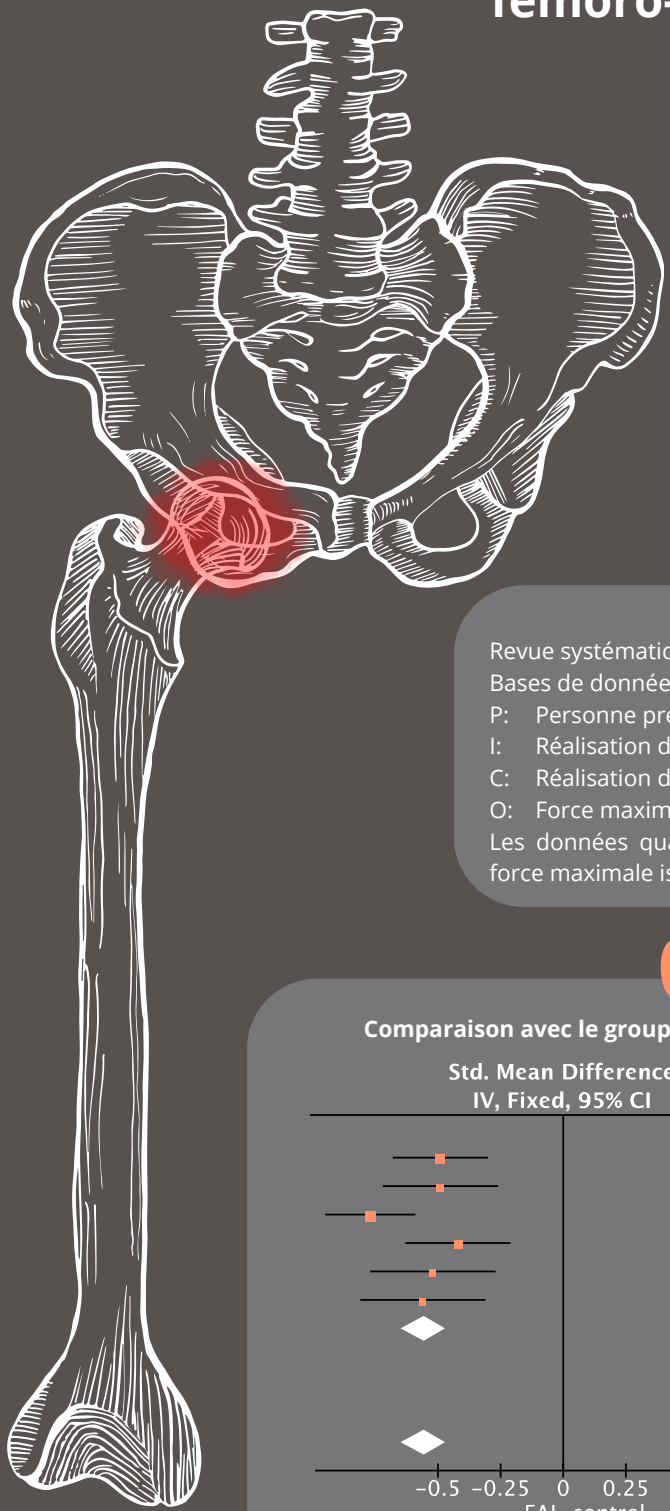
Les modifications de force isométrique maximale chez des personnes présentant un syndrome du conflit fémoro-acétabulaire



Introduction

Le conflit fémoro-acétabulaire (CFA) est une pathologie caractérisée par une morphologie atypique de la hanche, provoquant un contact anormal entre le fémur et le rebord acétabulaire[1]. Des études se sont déjà intéressées au déficit de force chez les personnes présentant un CFA, mais les preuves restent limitées[2]. Une meilleure compréhension des déficits est nécessaire.

Objectif de l'étude

Présenter un état des connaissances scientifiques au sujet de la force musculaire isométrique maximale autour de la hanche chez une personne atteinte d'un syndrome du CFA, comparé à un groupe contrôle ou au côté sain.

Méthode

Revue systématique et méta-analyse selon le *Cochrane Handbooks of systematic review*[3].
Bases de données utilisées: Cochrane, Embase, Pedro, Pubmed

P: Personne présentant un syndrome du CFA symptomatique
I: Réalisation d'un test de force
C: Réalisation d'un test de force sur le membre sain ou sur un groupe contrôle
O: Force maximale isométrique

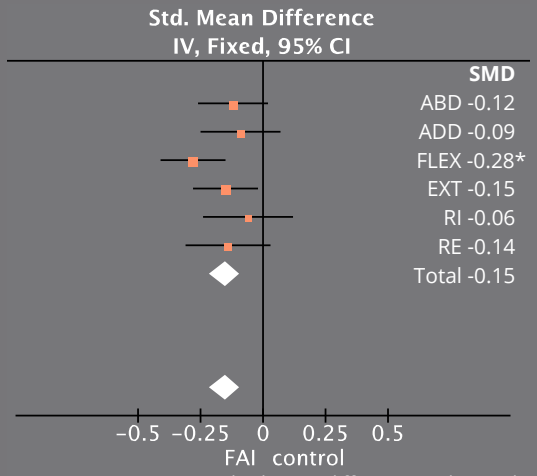
Les données quantitatives ont été traitées avec RevMan, celles-ci correspondent à la force maximale isométrique mesurée en N, Nm/kg, N/kg, lbs, lbs/kg

Résultats

Forest Plot

Comparaison avec le groupe contrôle

Comparaison avec le côté sain



CI, confidence interval; FAI, femoroacetabular impingement; IV, inverse variance; SMD; standard mean difference; Std., standard

Les valeurs significatives sont représentées par des *

Take home message

« Les faiblesses des muscles participant au mouvement de la hanche sont démontrées. Des études approfondies sur le renforcement spéficique de ces muscles sont nécessaires pour confirmer qu'une augmentation de la force musculaire est corrélée avec une diminution des douleurs. »

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Références

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Les modifications de force isométrique maximale chez des personnes présentant un syndrome du conflit fémoro-acétabulaire (CFA)

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Hes·so
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Résumé

Introduction

Le conflit fémoro-acétabulaire (CFA) est une pathologie caractérisée par une morphologie atypique de la hanche. Des études se sont déjà intéressées au déficit de force chez les personnes présentant un CFA, mais les preuves restent limitées. Une meilleure compréhension des déficits est nécessaire. L'objectif de ce travail est de présenter un état des connaissances scientifiques au sujet de la force musculaire isométrique maximale autour de la hanche chez une personne atteinte d'un syndrome du CFA, comparé à un groupe contrôle ou au côté sain.

Méthode

Ce travail est une revue systématique et méta-analyse. Les bases de données Cochrane, Embase, Pedro et PubMed ont été explorées. Le risque de biais des études a été évalué grâce à la *Downs & Black Checklist* modifiée. Les données quantitatives ont été traitées avec *RevMan,* celles-ci correspondent à la force maximale isométrique mesurée en N, Nm/kg, N/kg, lbs, lbs/kg

Résultats

20 études de design différent ont été incluses. Une différence significative de la force musculaire isométrique des fléchisseurs, extenseurs, abducteurs, adducteurs, rotateurs internes et externes entre les personnes atteintes d'un syndrome du CFA et un groupe contrôle a été observée. Une différence musculaire est aussi visible de manière significative entre le côté atteint et le côté sain de personnes présentant un syndrome du CFA au niveau des fléchisseurs de hanche.

Conclusion

Ces résultats démontrent une faiblesse musculaire significative chez les personnes atteintes d'un syndrome du CFA. Il serait intéressant de poursuivre les recherches afin d'analyser l'effet d'un renforcement spécifique en vue de l'amélioration des symptômes.

Mots-clés

Conflit fémoro-acétabulaire, force musculaire, faiblesse musculaire, isométrique, dynamomètre, isocinétique, contraction maximale.

Zusammenfassung

Einleitung

Das femoroacetabuläre Impingement (FAI) ist eine Erkrankung, die durch eine atypische Morphologie der Hüfte gekennzeichnet ist. Studien haben sich bereits mit dem Kraftdefizit bei Menschen mit FAI befasst, doch die Beweislage bleibt begrenzt. Ein besseres Verständnis der Defizite ist erforderlich. Das Ziel dieser Arbeit ist es, einen umfassenden Überblick über den aktuellen wissenschaftlichen Kenntnisstand zur maximalen isometrischen Muskelkraft im Bereich der Hüfte bei Personen mit FAI-Syndrom zu geben, im Vergleich zu einer Kontrollgruppe oder der gesunden Seite.

Methode

Diese Arbeit ist eine systematische Übersichtsarbeit mit Metaanalyse. Die Datenbanken Cochrane, Embase, Pedro und PubMed wurden durchsucht. Das Risiko von Studienverzerrungen wurde mithilfe der modifizierten *Downs & Black Checklist* bewertet. Die quantitativen Daten wurden mit *RevMan* verarbeitet, diese entsprechen der isometrischen Maximalkraft, gemessen in N, Nm/kg, N/kg, lbs, lbs/kg.

Resultate

Es wurden 20 Studien mit unterschiedlichen Designs einbezogen. Ein signifikanter Unterschied wurde in der isometrischen Muskelkraft der Beuger, Strecker, Abduktoren, Adduktoren, Innen- und Aussenrotatoren der Hüfte zwischen Personen mit FAI-Syndrom und einer Kontrollgruppe festgestellt. Auch bei den Hüftbeugern war ein beträchtlicher Muskelunterschied zwischen der betroffenen und der gesunden Seite von Personen mit FAI-Syndrom zu erkennen.

Schlussfolgerung

Diese Ergebnisse belegen eine signifikante Muskelschwäche bei Menschen mit FAI-Syndrom. Es wäre interessant, weitere Untersuchungen durchzuführen, um die Wirkung einer spezifischen Kräftigung zur Verbesserung der Symptome zu analysieren.

Schlüsselwörter

Femoro-azetabulärer Impingement, Muskelkraft, Muskelschwäche, isometrisch, Dynamometer, Isokinetik, Muskelmangel, maximale Kontraktion.

Abstract

Introduction

Femoro-acetabular impingement (FAI) is a pathology characterized by atypical hip morphology. Studies have already examined strength deficits in people with FAI, but evidence remains limited. A better understanding of the deficits is needed. The aim of this work is to present the state of scientific knowledge concerning maximal isometric muscle strength around the hip in a person with FAI syndrome, compared with a control group or the healthy side.

Method

This is a systematic review and meta-analysis. The Cochrane, Embase, Pedro and PubMed databases were searched. Studies were assessed for risk of bias using the modified Downs & Black Checklist. Quantitative data was processed using RevMan, these correspond to maximum isometric strength measured in N, Nm/kg, N/kg, lbs, lbs/kg.

Results

20 studies of different designs were included. A significant difference in isometric muscle strength in the flexors, extensors, abductors, adductors, internal and external rotators between people with FAI syndrome and a control group was observed. There was also a significant difference in hip flexor strength between the affected and healthy sides of people with FAI syndrome.

Conclusion

These results demonstrate significant muscle weakness in people with FAI syndrome. Further research to analyze the effect of specific strengthening on symptom improvement would be beneficial.

Key words

Femoro-acetabular impingement, muscle strength, muscle weakness, isometric, dynamometer, isokinetic, muscle deficiency, maximal contraction.

« Avertissement »

Les prises de position, la rédaction et les conclusions de ce travail n'engagent que la responsabilité de ses auteurs et en aucun cas celle de la Haute Ecole de Santé Valais, du Jury ou du Directeur du Travail de Bachelor. J'atteste/nous attestons avoir réalisé seul-e(s) le présent travail, sans avoir utilisé d'autres sources que celles indiquées dans la liste de références bibliographiques.

Lieu, date et nom du (des) auteur(s) :
Loèche-Les-Bains, le 7 juin 2024,

Gobet Julie

Tercier Maïté

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Liste des abréviations

Abd	Abduction
Add	Adduction
AP	Antéro-postérieur
CFA	Conflit fémoro-acétabulaire
CS	Côté sain
DMS	Déviation moyenne standard
DS	Déviation standard
EG	Effet global
Ext	Extension
F	Femme
FADIR	*Flexion, Adduction, Internal Rotation*
Flex	Flexion
GC	Groupe contrôle
H	Homme
HES	Haute Ecole Santé
IC	Intervalle de confiance
IJ	Ischio-jambiers
IRM	Imagerie par résonance magnétique
Lbs/kg	Pounds par kilogramme
Lbs	Pound
N	Newton
N/kg	Newton par kilogramme
Nm/kg	Newton mètre par kilogramme
PICO	*Population, Interventions, Comparators, Outcomes*
RE	Rotation externe
RevMan	*Review Manager*
RI	Rotation interne
TF	Torsion fémorale
TDM	Tomodensitométrie

Table des matières

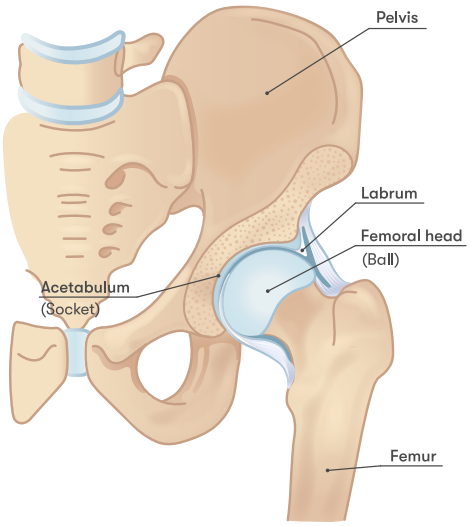
1 Introduction

1.1 Contexte général

Actuellement, les douleurs de hanche sont présentes chez les adultes de tout âge et de tout niveau d'activité (Chamberlain, 2021). De par une large possibilité de diagnostic différentiel, ces douleurs représentent un défi diagnostique et thérapeutique (Wilson & Furukawa, 2014). Plusieurs affections peuvent toucher l'articulation de la hanche, telles que le conflit fémoro-acétabulaire (CFA), la déchirure du labrum, la fracture, la nécrose avasculaire ou encore l'arthrose. Le diagnostic des causes de la douleur permet de proposer un traitement adéquat (Chamberlain, 2021). Certaines de ces pathologies, comme la dysplasie et le CFA peuvent conduire à de l'arthrose précoce de hanche (Ganz et al., 2003). Cette dégénérescence est courante, estimée à 25% de risque d'apparition chez une personne vivant jusqu'à 85 ans (Murphy et al., 2010). Pour la traiter, la méthode la plus courante est la pose d'une prothèse de hanche (Günther et al., 2021). En Suisse, selon les chiffres de 2019, la pose d'une prothèse totale de hanche chez une population à risque montrait une incidence de 555/100 000 (Beck et al., 2021). La progression de diverses pathologies, dont le syndrome du CFA, peuvent être ralenties par la prise en charge dans les premiers stades de la pathologie et par la mise en place d'interventions de rééducation (Freke et al., 2016). Les personnes avec un CFA symptomatique présentent un déficit de force musculaire. Cette perte peut s'expliquer par une inhibition de la contraction musculaire autour de la hanche en raison des douleurs ressenties (Freke et al., 2016). Ces déficits de force peuvent jouer un rôle dans la présentation symptomatique des personnes atteintes. Déterminer la prévalence de ces faiblesses musculaires permet d'élaborer des traitements non-chirurgicaux et/ou préopératoires pour améliorer la prise en charge de cette atteinte (Nepple et al., 2015).

1.1.1 L'articulation coxo-fémorale

Figure 1: Anatomie de la hanche



Tirée de : (InjuryMap, 2019)

L'articulation coxo-fémorale joue un rôle essentiel dans le corps humain. Depuis le passage à la position bipède, cette articulation est devenue un membre essentiellement porteur et locomoteur. C'est pourquoi, elle nécessite donc autant de stabilité que de mobilité. La hanche relie le tronc au membre inférieur, plus précisément, le fémur à l'os coxal. L'os coxal est composé de trois os soudés qui se réunissent en synostose à l'intérieur de l'acétabulum : l'ilion, le pubis et l'ischion. C'est exactement à cet endroit que vient s'emboîter la tête fémorale, extrémité proximale du fémur, pour former l'articulation coxo-fémorale. La tête du fémur est reliée à sa diaphyse par le col fémoral (Kapanji, 2018). Grâce à sa mobilité, cette articulation est considérée comme une diarthrose. La tête fémorale étant convexe et l'acétabulum concave, la rencontre entre ces deux dépeint un emboîtement parfait qui explique cette grande mobilité et cette grande congruence. Sa fonction d'orientation est expliquée par ses trois axes ainsi que ses trois degrés de liberté, qui définissent une énarthrose, c'est-à-dire « une articulation de type sphérique, très emboîtée » (Kapanji, 2018, p. 4). Un premier axe transversal définit les mouvements de flexion-extension, un deuxième axe sagittal décrit les mouvements d'abduction-adduction et un dernier axe décrit les mouvements de rotation externe et de rotation interne (Kapanji, 2018). Sur un plan structurel, cette articulation est classée comme une synoviale. Cette dernière est caractérisée par la possession de cartilage articulaire, d'une cavité articulaire, d'une capsule articulaire, de liquide synovial et de ligaments (Marieb, 2005). La capsule est une membrane fibreuse, épaisse et solide qui

entoure l'articulation. Fixée sur l'os coxal et le fémur, elle est renforcée par plusieurs ligaments extra-capsulaires : ligaments ilio-fémoral, pubo-fémoral, ischio-fémoral, ainsi que d'un ligament intracapsulaire : le ligament de la tête fémorale (Kapanji, 2018).

Les mouvements ainsi que la stabilité de la hanche sont possibles grâce à l'activation de nombreux muscles. Il est possible de classifier la musculature de la hanche selon différents critères (Platzer, 2014). Pour une raison de compréhension pour la suite de ce travail, voici une classification qui se rapporte à la fonction des muscles sur l'articulation.

Tableau 1: Muscles de la hanche

Mouvement	Muscles
Flexion	m. ilio-psoas m. tensor fascia latae m. pectineus m. adductor longus m. adductor brevis m. gracilis m. rectus femoris m. sartorius
Extension	m. glutaeus maximus m. glutaeus medius m. glutaeus minimus m. adductor magnus m. piriformis m. semimembranosus m. semitendinosus m. biceps femoris
Abduction	m. glutaeus medius m. tensor fascia latae m. glutaeus maximus m. glutaeus minimus m. piriformis m. obturatorius internus
Adduction	m. adductor magnus m. adductor minimus m. adductor longus m. adductor brevis m. glutaeus maximus m. gracilis m. pectineus m. quadratus femoris m. obturatorius externus m. semitendinosus
Rotation interne	m. glutaeus medius m. glutaeus minimus m. tensor fasciae latae m. adductor magnus m. pectineus (sur une jambe en abduction)
Rotation externe	m. glutaeus maximus m. quadratus femoris m. obturatorius internus m. glutaeus medius m. glutaeus minimus m. ilio-psoas m. obturatorius externus m. adductor magnus m. adductor minimus m. adductor longus m. adductor brevis m. piriformis m. sartorius

(Platzer, 2014)

1.2 Contexte pathologique : Le conflit fémoro-acétabulaire

1.2.1 Généralité

Le CFA se définit par des caractéristiques morphologiques atypiques de la hanche qui, lors de mouvement de fin d'amplitude, provoquent un contact anormal entre le fémur proximal et le rebord acétabulaire (Ganz et al., 2003). Cette affection est une des pathologies de hanche les plus courantes puisqu'elle représente environ 38% des pathologies de cette articulation (Hale et al., 2021). Son incidence globale, plus élevée chez les femmes que chez les hommes, est de 54.4 pour 100'000 personnes-années (Hale et al., 2021). L'étude de Hale et al. (2021) relate une augmentation du taux de diagnostic et de prise en charge entre les années 2000 et 2016. Ceci s'explique notamment par l'amélioration de la compréhension et de la documentation des cliniciens sur le syndrome du CFA (Hale et al., 2021). Cette pathologie se manifeste généralement chez les jeunes adultes actifs, elle est traduite par une douleur au pli de l'aine et n'est précédée d'ordinaire que de traumatismes mineurs (Ganz et al., 2003). Ce contact entraîne des lésions du labrum acétabulaire et du cartilage acétabulaire. Avec le temps, il en découle une dégénérescence de l'articulation (Ganz et al., 2003), surtout si la cause sous-jacente du conflit n'est pas traitée (Ganz et al., 2001). L'association entre une anomalie de la tête fémorale et l'apparition d'un risque élevé d'arthrose a été confirmée (Agricola et al., 2013). De même, l'étude de Nicholls et al. (2011), atteste d'une association entre une déformation de la tête fémorale et l'arthroplastie totale de la hanche. Comme cette pathologie peut découler sur d'autres troubles, il est important qu'elle soit prise en charge de manière sérieuse (Zhang et al., 2022). Poser un diagnostic de manière précoce est important, car le CFA provoque des lésions pathologiques de l'articulation et est considéré comme un symptôme précurseur de l'arthrose (Pålsson et al., 2020).

1.2.2 Diagnostic

Poser le diagnostic d'une pathologie de la hanche peut s'avérer difficile. En effet, les symptômes provenant des structures intra- et extra-articulaires ont des caractéristiques similaires (Martin et al., 2008). Le diagnostic d'un syndrome du CFA se fait en présence de symptômes, de signes cliniques et de résultats d'imagerie positifs (Griffin et al., 2016). Les personnes consultent fréquemment pour des douleurs et des défaillances, sans origine traumatique, qui ont progressé jusqu'à gêner leurs activités (Trigg et al., 2020). Ils relatent premièrement des douleurs au pli de l'aine lors de certains mouvements, comme la flexion, ou lors de certaines positions (Trigg et al., 2020). De nombreuses personnes

rapportent aussi des sensations de blocage, raideur, lâchage ou encore de limitation dans l'amplitude de mouvement (Griffin et al., 2016). Lorsqu'il s'agit de localiser leurs douleurs, les personnes démontrent de manière commune, une zone autour du grand trochanter, s'étendant d'antérieur vers latéral. Ce signe correspond au *C Sign*, couramment présent chez les personnes souffrant d'un CFA (Trigg et al., 2020).

Évaluer la mobilité s'avère bénéfique pour distinguer les pathologies de la hanche (Trigg et al., 2020). L'étude de Frasson et al. (2020) a comparé la mobilité de hanche entre les personnes présentant un CFA et un groupe contrôle : l'étude rapporte une amplitude de hanche diminuée en flexion passive, en rotation externe passive et active et en rotation interne active. Le test FADIR (*Flexion, Adduction, Internal Rotation*) est connu pour reproduire les douleurs présentes dans le CFA, il permet de différencier une atteinte intra- ou extra-articulaire. D'autres examens distinguent aussi ces atteintes, mais aucun n'est réellement spécifique au syndrome du CFA (Trigg et al., 2020). Finalement, selon Schmaranzer et al. (2021), la radiographie du bassin est la base du bilan diagnostique chez les personnes dont on soupçonne un CFA. Une radiographie antéro-postérieure (AP) centrée sur le pelvis et une vue latérale du col du fémur permet d'avoir une vue d'ensemble sur la hanche symptomatique et d'identifier les premières anomalies morphologiques (Griffin et al., 2016). Dans un deuxième temps, l'imagerie par résonance magnétique (IRM) ou la tomodensitométrie (TDM), permet de quantifier les difformités et les anomalies intra-articulaires, par exemple les lésions du labrum ou du cartilage (Trigg et al., 2020). Malgré les progrès de l'imagerie, celle-ci ne reste qu'une part du diagnostic (Trigg et al., 2020). En effet, une imagerie positive en l'absence de symptômes et de signes cliniques ne permet pas de diagnostiquer un syndrome de CFA (Griffin et al., 2016).

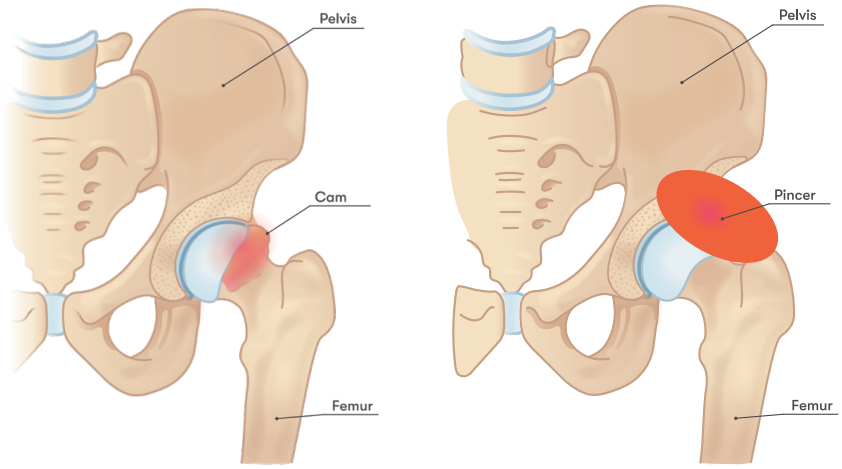
1.2.3 Types

On note trois types de morphologie anatomique à l'origine du CFA : la morphologie *cam*, la morphologie *pincer* et la forme mixte de ces deux dernières (Ganz et al., 2003). La morphologie *cam* est caractérisée par une déformation de la tête fémorale, entraînant un conflit avec la partie supérieure de l'acétabulum lors de la flexion et de la rotation interne (Trigg et al., 2020). Ce premier type est plus courant chez les jeunes hommes sportifs (Ganz et al., 2003). Il en résulte des forces de cisaillement sur le labrum et le cartilage qui peuvent conduire à une déchirure de ces structures (Ganz et al., 2003). La morphologie *pincer* décrit un recouvrement trop important de l'acétabulum sur la tête fémorale. Elle est généralement associée à une rétroversion acétabulaire (Trigg et al., 2020). Ici aussi, le

contact continu entre les structures entraîne une dégénérescence du labrum acétabulaire. Ce second type est présent davantage chez les femmes sportives d'un âge moyen (Ganz et al., 2003). Les modèles de dommages diffèrent selon le type de morphologie. En effet, les lésions du cartilage et du labrum dépendent de la forme de la hanche. Chez les personnes présentant un CFA de type *cam*, les lésions se situent au niveau du cartilage acétabulaire antéro-supérieur de l'acétabulum. Dans les hanches présentant un conflit en pincer, les atteintes se localisent de manière périphérique et ne comprennent qu'une étroite bande de cartilage acétabulaire (Beck et al., 2005). Selon une étude de Frank et al. (2015), la prévalence de la déformation de type *cam* est de 37% et celle de type *pincer* de 67%. Mais la morphologie la plus courante reste encore la forme mixte, type combiné entre les morphologies *cam* et *pincer* (Trigg et al., 2020). C'est grâce à une radiographie AP du bassin, centrée sur la symphyse pubienne, que ces différents types peuvent être distingués (Trigg et al., 2020).

L'étude de De Pina Cabral et al. (2020), met en évidence une association entre le CFA et la torsion fémorale (TF). La TF est l'angle entre le col du fémur et la diaphyse du fémur, indiquant le degré de torsion du fémur (Scorcelletti et al., 2020). Cet angle est un facteur d'influence important sur le syndrome du CFA, car il peut aggraver ou diminuer le conflit mécanique (Noebauer-Huhmann et al., 2023). Cette altération de torsion est présente chez près d'un tiers des personnes atteintes d'un CFA. Il est donc nécessaire de mesurer la TF dans cette pathologie (de Pina Cabral et al., 2020).

Figure 2: Types



Tirée de : (InjuryMap, 2019)

1.2.4 Force musculaire

Les faiblesses des muscles participant au mouvement de la hanche ont déjà été associées à des hanches pathologiques, notamment dans le cas de hanche arthrosique (Arokoski et al., 2002). Il paraît ainsi raisonnable de prédire un déficit de force chez les personnes présentant un CFA symptomatique, mais les preuves à l'appui restent limitées (Diamond et al., 2015). La revue systématique de Freke et al. (2016) met en évidence les déficits de certains muscles chez les personnes atteintes. Les résultats montrent des preuves limitées sur la force de flexion et des preuves modérées et contradictoires sur la force d'adduction et de rotation externe, en faveur du groupe contrôle (Freke et al., 2016). D'autres études, comme celle de Casartelli et al. (2011), attestent d'une force significativement inférieure pour les adducteurs (28%), les fléchisseurs (26%), les rotateurs externes (18%) et les abducteurs (11%). L'étude de Diamond et al. (2015) expose une faiblesse significative uniquement des abducteurs (20%). Ces faiblesses peuvent s'expliquer par l'inhibition de la contraction musculaire autour de la hanche, induite par la douleur (Freke et al., 2016). Une meilleure compréhension des déficits musculaires chez les personnes présentant un CFA symptomatique est nécessaire pour proposer des traitements conservateurs et également des programmes préopératoires susceptibles d'améliorer les résultats chirurgicaux (Diamond et al., 2015).

1.2.5 Traitement

Le CFA peut être traité soit de manière conservatrice, soit par rééducation, soit par chirurgie. Chacun des trois axes joue un rôle dans la prise en charge des différentes personnes (Griffin et al., 2016). Comme cette pathologie découle d'une anomalie mécanique, un fort argument va en direction d'une chirurgie pour corriger ce conflit (Ganz et al., 2003). Cependant, le traitement conservateur donne aussi des bons résultats, pour autant que les personnes puissent modifier et adapter leurs activités à leur morphologie de hanche (Emara et al., 2011). Il permet de soulager les symptômes, retarder, voir même annuler la nécessité d'opérer (Emara et al., 2011). Il existe différents axes de traitement pour une prise en charge conservatrice : modifier l'activité, éviter des mouvements excessifs ou repos, physiothérapie, ostéopathie et chiropractie, prise d'anti-inflammatoires non stéroïdiens et injections intra-articulaires de corticostéroïdes (Wall et al., 2013). Si ce traitement initial échouait, une opération serait envisagée, et cela dans le but d'éviter une progression de la pathologie vers une phase finale d'arthrose (Emara et al., 2011). Par la compréhension grandissante du CFA, une diversité de techniques

chirurgicales peut être utilisée. Ces techniques comprennent la luxation chirurgicale de la hanche, l'ostéotomie péri-acétabulaire, l'arthroscopie de la hanche combinée à une exposition ouverte limitée et d'autres techniques arthroscopiques (Clohisy et al., 2010). Toutes les études incluses dans la revue systématique de Clohisy et al. (2010) traitant du traitement chirurgical montrent, à court terme, une évolution favorable de la douleur et de la fonction chez la majorité des personnes. En 2013, l'étude de Wall et al. (2013) affirmait que la littérature au sujet du traitement non chirurgical du CFA manquait de preuves cliniques et qu'il existait un nombre important d'articles de synthèse et/ou de discussion exprimant une opinion de promotion de soins non chirurgicaux plutôt que de véritables conseils fondés sur des preuves. Depuis, cinq études randomisées contrôlées ont comparé l'arthroscopie au traitement conservateur chez les personnes présentant un CFA. Après 12 mois, trois études affirmaient que le traitement par arthroscopie indiquait des meilleurs résultats par rapport au traitement conservateur (Griffin et al., 2022; Hunter et al., 2021; Murphy et al., 2017). L'étude de Palmer et al. (2019) montre les mêmes résultats mais la comparaison est réalisée à huit mois. Seule l'étude de Mansell et al. (2018) ne montre pas de différence significative entre les deux groupes après 24 mois. Un suivi à long terme est encore nécessaire pour trouver la meilleure stratégie (Griffin et al., 2022).

1.3 Contexte physiothérapique

La prise en charge conservative est considérée comme la première étape du traitement après le diagnostic de CFA (Pasculli et al., 2023). La physiothérapie montre des effets positifs sur la douleur ainsi que sur la fonction articulaire (Kemp et al., 2018). Selon Trigg et al. (2020), la palette de traitements physiothérapiques se focalise principalement sur la stabilité du tronc, la proprioception et sur la stabilité dynamique de la hanche par un renforcement ciblé de la musculature. En effet, de nombreuses études, comme celle de Mayne et al. (2017), s'accordent sur une diminution de la force musculaire chez les personnes atteintes du CFA. Il est donc nécessaire de mettre en évidence quels muscles sont les plus atteints dans le cadre de cette pathologie et ainsi, de pouvoir proposer un traitement conservateur adéquat et efficace (Mayne et al., 2017). Une évaluation musculaire est importante, car celle-là permet d'individualiser la prise en charge et d'être plus précis et efficace dans le renforcement de ces faiblesses musculaires (Mayne et al., 2017). Bien que la physiothérapie montre des effets bénéfiques (Kemp et al., 2018) la méta-analyse de Gatz et al. (2020) démontre que l'arthroscopie de la hanche permet

d'obtenir des meilleurs résultats et considère donc cette technique comme le traitement adéquat de cette pathologie. Cependant, un traitement conservateur devrait précéder avant d'envisager une chirurgie (Mallets et al., 2019).

1.3.1 Évaluation de la force musculaire

L'évaluation de la force joue un rôle important dans l'examen clinique de la hanche (Holmich et al., 2004). Les tests de force isocinétique sont largement reconnus comme la méthode privilégiée, notamment grâce à leur validité et à leur reproductibilité bien établies (Almosnino et al., 2012; Maffiuletti et al., 2007; Pereira De Carvalho Froufe Andrade et al., 2013). Les mesures de la force effectuées grâce à un dynamomètre manuel restent avantageuses en termes de coût et de facilités par rapport au test isocinétique (Thorborg et al., 2010). Ces tests de dynamométrie peuvent être réalisés de deux manières différentes : le *make test* et le *break test*. Le *make test* est caractérisé par le maintien statique du dynamomètre par l'examinateur pendant que le sujet exerce une force maximum contre l'appareil. Alors que pendant le *break test*, l'examinateur pousse le dynamomètre contre le membre du sujet qui exerce une force maximum. Ces deux tests mesurent la force volontaire maximale du muscle, mais dans des conditions différentes (Bohannon, 1988). Les tests de dynamométrie se sont avérés fiables dans différentes études (Bohannon & Andrews, 1987; Jaramillo et al., 1994; Wang et al., 2002). Selon Stratford et Balsor (1994), le *make test* est plus fiable que le *break test*. Ils font l'hypothèse que cette différence est due aux compétences supplémentaires requises de la part de l'examinateur (Stratford & Balsor, 1994). L'étude de Thorborg et al. (2010), comme celle de Magnussson et al. (1990) se mettent d'accord sur le fait que l'utilisation du dynamomètre montre moins de variations de mesure test-retest que le test isocinétique. Il n'y a donc pas d'argument contre l'utilisation du dynamomètre pour mesurer la force, que ce soit à des fins cliniques ou de recherche (Thorborg et al., 2010).

1.4 Objectif de notre étude

Les études traitant de cette pathologie se sont particulièrement développées durant ces deux dernières décennies (Agricola & Weinans, 2016) et le diagnostic de CFA est de plus en plus fréquent (Mayne et al., 2017), avec pour incidence la déformation morphologique de type cam à 24.7% chez les hommes et 5.4% chez les femmes. Pourtant, à ce jour, la littérature sur les modifications musculaires dans le contexte du CFA reste encore mineure (Mayne et al., 2017). Afin d'éviter les complications secondaires et de traiter les

personnes atteintes d'un CFA de la meilleure manière qui soit, il est nécessaire d'approfondir ce sujet (Mayne et al., 2017).

Des revues systématiques ont déjà été publiées sur un sujet similaire.

- *Physical impairments and activity limitations in people with femoroacetabular impingement: a systematic review* (Diamond et al., 2015)
- *Physical impairments in symptomatic femoroacetabular impingement: a systematic review of the evidence* (Freke et al., 2016)
- *Measuring hip muscle strength in patients with femoroacetabular impingement and other hip pathologies: a systematic review* (Mayne et al., 2017)

Cependant, ces trois revues systématiques n'incluent que trois études spécifiques aux modifications de force musculaire isométrique dans le cadre du CFA, la source principale de ces trois articles étant l'étude de Casartelli et al. (2011). De plus, ces revues méritent d'être actualisées puisque la plus récente date de 2017. Il est donc important de poursuivre les recherches à ce sujet, notamment en utilisant des ressources plus récentes. Le but de cette revue systématique et méta-analyse est de synthétiser les connaissances sur les modifications musculaires autour de la hanche. L'objectif de notre étude est de présenter un état des connaissances scientifiques au sujet des modifications de force musculaire isométrique maximale autour de la hanche chez une personne atteinte d'un syndrome du CFA, en comparaison avec leur côté sain ou un groupe contrôle.

1.5 Question de recherche

Quelle est la différence de force isométrique maximale des muscles de la hanche chez des personnes présentant un syndrome du conflit fémoro-acétabulaire (CFA) symptomatique et n'ayant pas reçu de traitement chirurgical, en comparaison avec leur côté sain ou un groupe contrôle ?

2 Méthode

Notre revue systématique et méta-analyse a été rédigée selon les recommandations du *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

2.1 Stratégie de recherche

La méthode de recherche PICO *(Population, Interventions, Comparators, Outcomes)*, décrite par Cochrane (McKenzie et al., 2023) a été mise en place pour réaliser les recherches :

Population : Personne présentant un syndrome du CFA symptomatique

Intervention : Réalisation d'un test de force

Comparaison : Réalisation d'un test de force sur le membre sain ou sur un groupe contrôle

Outcome : Force maximale isométrique

Ce PICO a permis de créer une équation de recherche. Elle a ensuite été adaptée et entrée dans les différentes bases de données : *Pubmed, Embase, Cochrane et PEDro* (annexe I). Les recherches booléennes ont été faites jusqu'au 23 février 2024. Il n'y a pas de limitation selon l'année de publication ou le pays de recherche.

2.2 Sélection des études

Tous les articles trouvés grâce à l'équation de recherche ont ensuite été extraits et placés dans une première bibliothèque sur le logiciel *Zotero* (Takats et al., 2023). Ensuite, une deuxième bibliothèque a été créée où les doublons ont été exclus. Tous les articles de cette deuxième bibliothèque ont été insérés dans le logiciel *Rayyan* (Ouzzani et al., 2016). Ce logiciel a permis un premier tri en double aveugle, basé sur les titres et les résumés d'articles. Une dernière sélection a été réalisée après la lecture intégrale des articles, basée sur des critères d'inclusions et d'exclusions. Les divers conflits de chaque étape ont été réglés par consensus. Pendant le processus de sélection d'articles, il a été choisi de ne pas se limiter à un design précis afin d'accroître les recherches. Les références des études incluses ont été parcourues afin de garantir l'inclusion de tous les articles traitant du sujet.

2.3 Critères d'inclusions et d'exclusions

Le tableau 2 affiche les critères appliqués pour l'inclusion et l'exclusion des études.

Tableau 2: Critères d'inclusions et d'exclusions

Critères d'inclusions	**Critères d'exclusions**
Les participants ont un diagnostic clinique et/ou par imagerie d'un CFA	Les participants ont subi une opération de la hanche ou du membre inférieur antérieurement
L'étude donne des résultats de mesure de force isométrique maximale d'au moins un groupe musculaire de la hanche	Les études sont rédigées dans une langue autre que le français, l'anglais, l'allemand ou l'espagnol
L'étude réalise une comparaison de force du membre atteint avec le membre sain ou avec un groupe contrôle	Les mots-clés recherchés ne figurent pas dans le titre et/ou le résumé de l'article

CFA : Conflit fémoro -acétabulaire

2.4 Traitement des données

Dès lors que les études ont été sélectionnées, un tableau global (tableau 3) afin d'avoir une vision d'ensemble a été créé. Ensuite, un tableau a été réalisé pour chaque composante de mouvement (abduction, adduction, flexion, extension, rotation externe, rotation interne) et les études ont été séparées selon leur comparaison, membre sain ou groupe contrôle. La moyenne, la déviation moyenne standard (DMS) et le nombre de participants de chaque groupe a été inséré dans le tableau. Quatre études ont nécessité l'utilisation de *WebPlotDigitizer* (Rohatgi, 2022) pour l'extraction des données présentées sous forme de graphique : Bizzini et al. (2023), Brunner et al. (2015), Gonçalves et al. (2023) et Konnaris et al. (2023). Plusieurs données des études ont été paramétrées dans le logiciel *Review Manager* (*RevMan*) (The Cochrane Collaboration, 2020) afin de créer des diagrammes en forêt. Étant donné la nature non dichotomique des articles, les résultats continus ont été sélectionnés. Le modèle d'analyse choisi est un effet fixe car l'impact de l'intervention est commun à toutes les études (Nikolakopoulou et al., 2014). Compte tenu des différentes unités de mesures utilisées pour évaluer la force, la mesure de l'effet a été effectuée grâce à la DMS. L'intervalle de confiance (IC) à 95% permet une optimisation de l'erreur statistique et de la précision des résultats et correspond au seuil de la valeur P (Schünemann et al., 2023).

2.5 Valeurs seuil pour l'analyse

L'hétérogénéité des résultats a été calculée statistiquement. Selon Deeks et al. (2023), un I^2 inférieur à 40% est considéré comme hétérogénéité faible, entre 30-60% comme modéré, entre 50-90% comme substantiel et entre 75-100% comme considérable. Quand la valeur P est inférieure à 0.05, l'effet de l'intervention est jugé comme statistiquement significatif (Schünemann et al., 2023). La taille de l'effet global (EG) a été interprétée selon les valeurs suivantes : 0.2 correspond à un effet faible, 0.5 à un effet modéré et une valeur 0.8 à un grand effet (Cohen, 1988).

2.6 Évaluation de la qualité des études

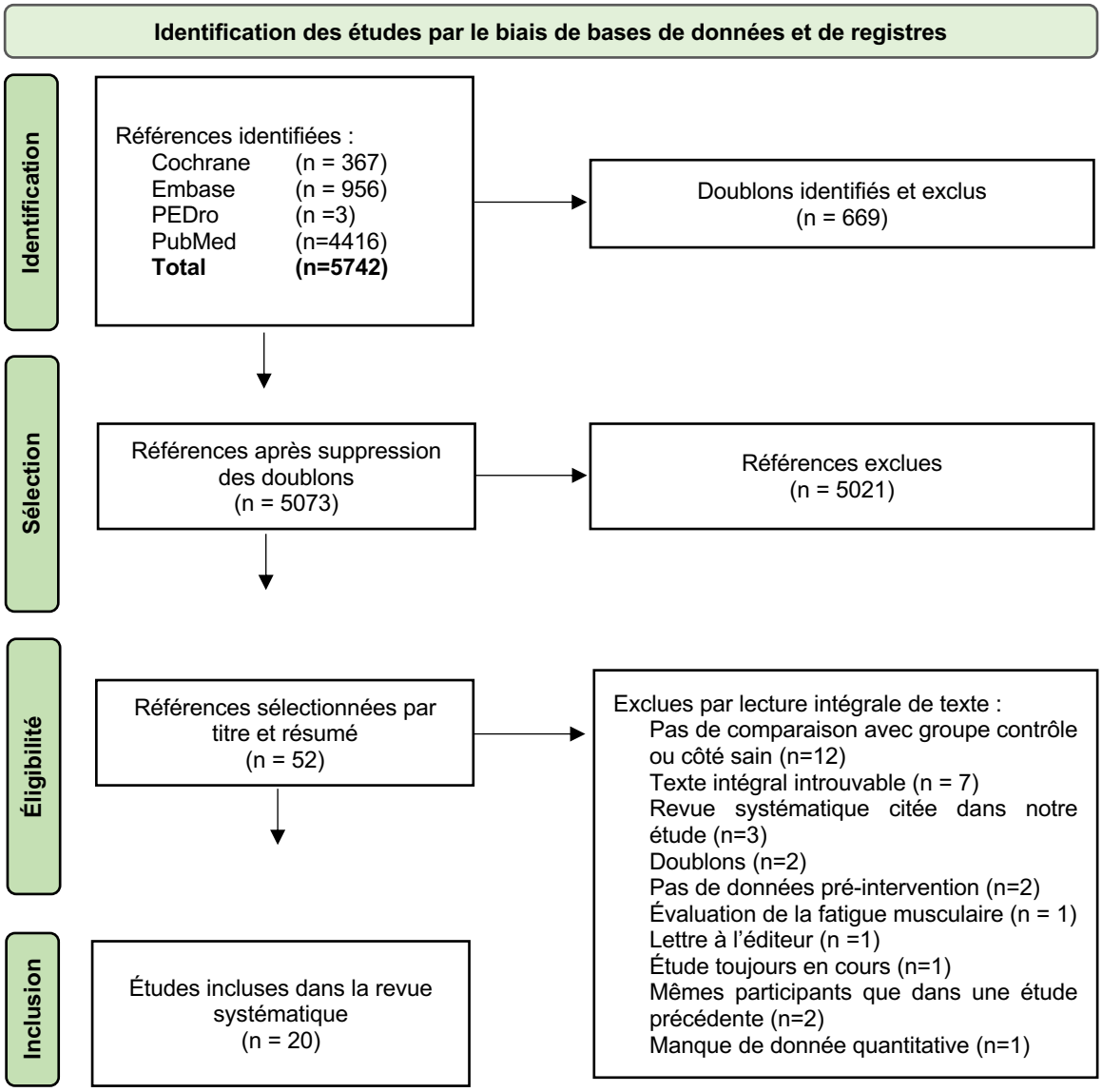
L'analyse de la qualité méthodologique a été réalisée en double aveugle, par deux examinateurs indépendants. Les désaccords ont été résolus par consensus. L'analyse de qualité a été réalisée à l'aide de la *Downs & Black Checklist*, répondant à une fiabilité et à une validé suffisante pour évaluer les études randomisées et non randomisées (Downs & Black, 1998). Les auteurs ont décidé d'utiliser la version modifiée par Freke et al. (2016), excluant 10 items (4, 13, 14, 15, 17, 19, 22, 23, 24 et 27) des 27 originaux. Ainsi, seuls les items applicables aux études non-randomisées ont été inclus dans cette checklist modifiée. Ce choix s'explique par la nature des études incluses dans ce travail et par l'absence d'étude randomisée contrôlée. D'après Veenhof et al. (2012), les questionnaires de qualité des études qui montrent un résultat de plus de 60% sont considérées de bonne qualité.

3 Résultats

3.1 Études incluses

Dans la figure 3 ci-dessous, le diagramme de flux des données représente le processus de sélection des études. Un total de 5'742 articles a été extrait dans les bases de données Cochrane (367), Embase (956), PEDro (3), PubMed (4'416). Ensuite, 669 doublons ont été reconnus et exclus. 5073 articles ont été conservés pour un premier tri par titres et résumés. Ce tri a permis de sélectionner 52 articles potentiellement éligibles. La lecture intégrale de texte a permis d'exclure 32 articles. Finalement, 20 articles ont été inclus dans cette revue systématique et méta-analyse.

Figure 3: Diagramme de flux



3.2 Description des études incluses

Les caractéristiques des études incluses sont présentées dans le tableau 3 ci-dessous. Les critères d'inclusions du syndrome du CFA sont basés sur les symptômes, les signes cliniques et l'imagerie. Parmi les 20 études incluses, 15 évoquent l'utilisation des trois critères pour le diagnostic du syndrome du CFA. Les personnes incluses dans les études de Casartelli et al. (2011), Kierkegaard et al. (2017) et Servant et al. (2022) ont été sélectionnées en vue d'une opération chirurgicale. Les trois critères ne sont pas explicitement décrits, mais peuvent être déduits par l'opération. Les personnes incluses dans l'étude de Kivlan et al. (2016) n'ont pas été diagnostiquées à l'aide de l'imagerie, mais uniquement par symptômes et signes cliniques. L'étude de Guenther et al. (2012) ne spécifie pas l'utilisation de signes cliniques pour l'inclusion.

Toutes les études incluses pour cette revue systématique et méta-analyse évaluent au moins une composante de mouvement.

Les mesures de forces isométriques sont principalement effectuées à l'aide d'un dynamomètre manuel validé et d'un dynamomètre isocinétique. Deux études utilisent néanmoins un dynamomètre customisé : Davis et al. (2016) et Gonçalves et al. (2023).

Huit études permettent une comparaison entre la force du côté sain et du côté atteint et 10 études admettent une comparaison entre la force d'un groupe contrôle à la force d'un groupe atteint du syndrome du CFA. Deux études donnent les valeurs comparant les personnes atteintes d'un syndrome du CFA avec leur côté sain ainsi qu'à un groupe contrôle : Bizzini et al. (2023), Kierkegaard et al. (2017).

Plusieurs designs d'études sont présentés : trois *case series*, sept *cross-sectional studies*, quatre *controlled laboratory studies*, deux *cases control*, une *single cohort descriptive and correlational study*, une *quasi-experimental cohort comparison*, une *prospective cohort study* et une *retrospective exploratory study*.

Le nombre de hanches testées varie entre 22 et 190 selon les études. Le nombre total de hanches testées est de 1'450.

Les résultats de forces musculaires sont donnés en newton par kilogramme (N/kg), newton mètre par kilogramme (Nm/kg), newton (N), pounds par kilogramme (lbs/kg) ou en pound (lbs).

Tableau 3: Caractéristiques des études incluses évaluant l'effet d'un syndrome du CFA sur les fonctions musculaires

Caractéristiques des études incluses évaluant l'effet d'un syndrome du CFA sur les fonctions musculaires

	Caractéristiques de l'étude					Caractéristiques de l'échantillon			Résultats		
Etudes (score totale sur la *Downs and Black Checklist* modifiée)	**Critères d'inclusion**	**Résultats mesurés**	**Méthodes de mesures**	**Comparaison**	**Design d'étude**	**Taille échantillon**	**Sexe**	**Age (année)**	**Moyenne groupe atteint (SD)**	**Moyenne groupe contrôle (SD)**	**Ampleur DMS (95% CI)**
Beck et al. (2020) (12/17)	Symptômes, signes cliniques, imagerie	Flex, ext, abd, RI, RE	Dynamomètre manuel (Lafayette Manual Muscle Testing System, Model 12-0380; Lafayette Instrument CO)	CS	*Case series*	74 atteints 74 sains	17H/57F 17H/57F	31.9 (12.4)	Flex 27.5 N/kg (10.5) Ext 33.6 N/kg (17.7) Abd 23.5 N/kg (10.2) RI 14.6 N/kg (5.9) RE 12.9 N/kg (4.9)	Flex 31.2 N/kg (10.3) Ext 37.6 N/kg (20.6) Abd 25.2 N/kg (8.9) RI 14.7 N/kg (5.9) RE 14.5 N/kg (5.5)	Flex -0.35 (-0.68; -0.03) Ext -0.21 (-0.53; 0.12) Abd -0.18 (-0.50; 0.15) RI -0.02 (-0.34 ; 0.31) RE -0.31 (-0.63 ; 0.02)
Bizzini et al. (2023) (9/17)	Symptômes, signes cliniques, imagerie	Flex, abd, add	Dynamomètre (GroinBar, Vald Performance Inc., Albion, Australia)	GG	*Cross-sectional comparative study*	40 CFA 40 GC	20H/20F 20H/20F	28 (7) /30 (6) 26 (5) /27 (4)	Homme Flex 4.1 (1.09) N/kg Abd 1.79 (0.51) N/kg Add 1.93 (0.48) N/kg Femme Flex 3.24 (1.16) N/kg Abd 1.57 (0.54) N/kg Add 1.68 (0.49) N/kg	Homme Flex 4.98 (1.2) N/kg Abd 2.27 (0.45) N/kg Add 2.45 (0.7) N/kg Femme Flex 3.89 (1.13) N/kg Abd 1.84 (0.44) N/kg Add 1.77 (0.43) N/kg	Homme Flex -0.75 (1.19; 0.08) Abd -0.98 (-1.64; -0.32) Add -0.85 (-1.50; 0.20) Femme Flex -0.56 (-1.19; 0.08) Abd -0.54 (-1.17; 0.09) Add -0.19 (-0.81; 0.43)
Bizzini et al. (2023) (9/17)	Symptômes, signes cliniques, imagerie	Flex, abd, add	Dynamomètre (GroinBar, Vald Performance Inc., Albion, Australia)	CS	*Cross-sectional comparative study*	40 atteints 40 sains	20H/20F 20H/20F	28 (7) /30 (6) 26 (5) /27 (4)	Homme Flex 4.11 (1.09) N/kg Abd 1.79 (0.51) N/kg Add 1.93 (0.48) N/kg Femme Flex 3.24 (1.28) N/kg Abd 1.56 (0.54) N/kg Add 1.68 (0.49) N/kg	Homme Flex 4.33 (1.02) N/kg Abd 1.97 (0.42) N/kg Add 1.93 (0.52) N/kg Femme Flex 3.42 (1.09) N/kg Abd 1.69 (0.54) N/kg Add 1.73 (0.38) N/kg	Homme Flex -0.15 (-0.77; 0.47) Abd -0.38 (-1.00; 0.25) Add 0.00 (-0.62; 0.61) Femme Flex -0.20 (-0.83; 0.42) Abd -0.24 (-0.86; 0.39) Add -0.11 (-0.73; 0.51)
Brunner et al. (2015) (11/17)	Symptômes, signes cliniques, imagerie	Abd, add, RI, RE Flex, ext	Dynamomètre stabilisé (Nicholas Manual Muscle Tester ; Lafayette Inc) Isokinetic dynamometer (Biodex System 4 ; Biodex Medical Systems)	GC	*Controlled laboratory study*	16 CFA 24 GC	16H 24H	16.7 (1.6) 16.4 (1.9)	Abd 2.1 (0.23) Nm/kg Add 3.1 (0.47) Nm/kg Ext 3.39 (0.58) Nm/kg Flex 1.9 (0.26) Nm/kg RI 1.1 (0.27) Nm/kg RE 0.9 (0.12) Nm/kg	Abd 2.11 (0.22) Nm/kg Add 3.1 (0.5) Nm/kg Ext 4.11 (0.62) Nm/kg Flex 2.17 (0.27) Nm/kg RI 1.1 (0.18) Nm/kg RE 1 (0.11) Nm/kg	Abd -0.04 (-0.68; 0.59) Add 0.00 (-0.63; 0.63) Ext -1.17 (-1.85; -0.48) Flex -0.99 (-1.67; -0.32) RI 0.00 (-0.63; 0.63) RE -0.86 (-1.52; -0.20)
Casartelli et al. (2011) (10/17)	Signes clinique et imagerie	Abd, add, RI, RE Flex, ext	Dynamomètre manuel (Nicholas Manual Muscle Tester, Lafayette Inc., Lafayette, IN, USA) Dynamomètre isocinétique (Biodex System 2, Biodex Medical Systems, New York, USA)	GC	*Cross-sectional, comparative study*	22 CFA 22 GC	8H/14F 8H/14F	32.0 (9.0) 32.0 (9.0)	Flex 0.87 (0.46) Nm/kg Ext 1.64 (1.00) Nm/kg Abd 1.81 (0.43) Nm/kg Add 1.57 (0.82) Nm/kg RI 0.47 (0.16) Nm/kg RE 0.46 (0.21) Nm/kg	Flex 1.17 (0.37) Nm/kg Ext 1.66 (0.86) Nm/kg Abd 2.03 (0.31) Nm/kg Add 2.17 (0.49) Nm/kg RI 0.55 (0.17) Nm/kg RE 0.56 (0.15) Nm/kg	Flex -0.71 (-1.32; -0.09) Ext -0.02 (-0.61; 0.57) Abd -0.77 (-1.38; -0.15) Add -0.87 (-1.49; -0.25) RI -0.48 (-1.08; 0.12) RE -0.54 (-1.14; 0.06)
Catelli et al. (2018) (11/17)	Symptômes, signes cliniques, imagerie	Flex, ext, abd, flex + abd, flex genou	Dynamomètre manuel (Manual Muscle Testing System Model 01163; Lafayette instrument)	GC	*Controlled laboratory study*	16 CFA 18 GC	14H/2F 16H/2F	38.5 (8) 32.8 (7)	Flex 1.56 (0.62) Nm/kg Ext 1.62 (0.82) Nm/kg Abd 1.39 (0.45) Nm/kg	Flex 2.11 (0.63) Nm/kg Ext 1.69 (0.67) Nm/kg Abd 1.60 (0.51) Nm/kg	Flex -0.86 (-1.57; -0.15) Ext -0.09 (-0.77; 0.58) Abd -0.49 (-1.17; 0.20)
Catelli et al. (2019) (9/17)	Symptômes, signes cliniques, imagerie	Flex, ext, abd, flex + abd	Dynamomètre manuel (Model 01163, Lafayette Instrument, Lafayette, LA, USA)	GC	*Case control*	11 CFA 11 GC	11H 11H	34.1 (6.4) 36.2 (7.4)	Flex 1.78 (0.51) Nm/kg Ext 1.84 (0.56) Nm/kg Abd 1.54 (0.31) Nm/kg	Flex 2.16 (0.6) Nm/kg Ext 1.47 (0.46) Nm/kg Abd 1.59 (0.47) Nm/kg	Flex -0.66 (-1.52; 0.21) Ext 0.69 (-0.17; 1.56) Abd -0.12 (-0.96; 0.72)
Davis et al. (2016) (9/17)	Symptômes, signes cliniques, imagerie	Abd	Dynamomètre customisé avec une jauge de contrainte	CS	*Single cohort descriptive and correlational study*	40 atteints 40 sains	18H/22F 18H/22F	24.9 (9.9)	Abd 0.30 (0.10) lbs/kg	Abd 0.31 (0.09) lbs/kg	Abd -0.10 (-0.63; 0.42)

Diamond et al. (2015) (10/17)	Symptômes, signes cliniques, imagerie	Flex, ext, abd, add, RI, RE	Dynamomètre manuel (Lafayette Manual Muscle Tester 01160/ 01163/ 01165 ; Lafayette instrument Compagny, Indiana. USA)	GC	*Cross-sectional*	15 CFA 14 GC	11H/4F 10H/4F	24.7 (4.9) 27.1 (4.5)	Flex 0.98 (0.28) Nm/kg Ext 0.87 (0.47) Nm/kg Abd 1.17 (0.32) Nm/kg Add 1.20 (0.41) Nm/kg RI 0.58 (0.29) Nm/kg RE 0.79 (0.21) Nm/kg	Flex 1.16 (0.30) Nm/kg Ext 1.13 (0.37) Nm/kg Abd 1.47 (0.43) Nm/kg Add 1.37 (0.37) Nm/kg RI 0.76 (0.20) Nm/kg RE 0.84 (0.18) Nm/kg	Flex -0.60 (-1.35; 0.14) Ext -0.59 (-1.34; 0.15) Abd -0.77 (-1.53; -0.01) Add -0.42 (-1.16; 0.32) RI -0.70 (-1.45; 0.06) RE -0.25 (-0.98; 0.48)
Ebert et al. (2023) (13/17)	Symptômes, signes cliniques, imagerie	Flex, ext, abd, RI, RE	Dynamomètre manuel (Commander Powertrack II; J-Tech Medical)	CS	*Case series*	44 atteints 44 sains	28H/16F 28H/16F	32.8 (10.6)	Flex 55.6 (14.7) lbs Ext 52.8 (19.7) lbs Abd 28.5 (13.1) lbs Add 23.5 (9.5) lbs RI 20.2 (6.6) lbs RE 28.5 (13.1) lbs	Flex 60.06 (14.8) lbs Ext 58.4 (19.0) lbs Abd 30.7 (10.5) lbs Add 24.2 (9.8) lbs RI 22.9 (7.0) lbs RE 29.9 (12.5) lbs	Flex -0.33 (-0.84; 0.18) Ext -0.29 (-0.79; 0.22) Abd -0.30 (-0.81; 0.21) Add -0.07 (-0.58; 0.43) RI -0.39 (-0.90; 0.12) RE -0.11 (-0.61; 0.40)
Frasson et al. (2020) (11/17)	Symptômes, signes cliniques, imagerie	Flex, ext, abd, add	Dynamomètre manuel (MICROFET – Hoogan Scientific, Salt Lake City, USA)	GC	*Cross-sectional, case control*	20 CFA 20 GC	20H 20H	28.1 (6.0) 27.9 (5.0)	Flex 1.55 (0.41) Nm/kg Ext 1.59 (0.50) Nm/kg Abd 1.42 (0.36) Nm/kg Add 1.21 (0.44) Nm/kg	Flex 2.08 (0,48) Nm/kg Ext 2.40 (0.61) Nm/kg Abd 1.60 (0.37) Nm/kg Add 1.80 (0.45) Nm/kg	Flex -1.16 (-1.84; 0.49) Ext -1.42 (-2.12; -0.72) Abd -0.48 (-1.11; 0.15) Add -1.30 (-1.99; -0.61)
Gonçalves et al. (2023) (12/17)	Symptômes, signes cliniques, imagerie	Flex, ext, abd, add, RI, RE	Dynamomètre customisé composé d'une cellule de charge uniaxiale attaché à un châssis métallique	GC	*Controlled laboratory study*	15 CFA 18 GC	11H/3F 9H/9F	30.6 (5.2) 25.2 (5.8)	Flex 1.12 (0.16) Nm/kg Ext 1.88 (0.32) Nm/kg Abd 1.04 (0.2) Nm/kg Add 1.37 (0.31) Nm/kg RI 0.68 (0.21) Nm/kg RE 0.54 (0.13) Nm/kg	Flex 1.41 (0.26) Nm/kg Ext 1.67 (0.34) Nm/kg Abd 1.09 (0.17) Nm/kg Add 1.35 (0.3) Nm/kg RI 0.7 (0.13) Nm/kg RE 0.56 (0.13) Nm/kg	Flex -1.29 (-2.04; -0.54) Ext 0.62 (-0.07; 1.31) Abd -0.26 (-0.94; 0.41) Add 0.06 (-0.61; 0.74) RI -0.11 (-0.79; 0.56) RE -0.15 (-0.82; 0.52)
Guenther et al. (2012) (9/17)	Symptômes et imagerie	Abd, add, RI, RE	Dynamomètre manuel	GC	*Cross-sectional, comparative study*	17 CFA 11 GC	13H/4F 5H/6F	29.4 (7.0) 28.0 (4.3)	Abd 1.08 (0.40) Nm/kg Add 1.20 (0.38) Nm/kg RI 0.53 (0.16) Nm/kg RE 0.56 (0.18) Nm/kg	Abd 1.27 (0.25) Nm/kg Add 1.49 (0.33) Nm/kg RI 0.83 (0.22) Nm/kg RE 0.74 (0.12) Nm/kg	Abd -0.53 (-1.30; 0.25) Add -0.78 (-1.57; 0.01) RI -1.57 (-2.45; -0.69) RE -1.09 (-1.91; -0.28)
Kierkegaard et al. (2017) (10/17)	Symptômes et imagerie	Flex, ext	Dynamomètre isocinétique (Humac Norm, CSMi, Stoughton, Massachusetts, USA)	GC	*Cross-sectional, comparative study*	60 CFA 30 GC	22H/38F 12H/18F	36.9 (9.0) 36.9 (9.0)	Flex 1.5 (0.7) Nm/kg Ext 2.5 (1.1) Nm/kg	Flex 1.9 (0.4) Nm/kg Ext 3 (0.8) Nm/kg	Flex -0.64 (-1.09; -0.19) Ext -0.49 (-0.93; -0.05)
Kierkegaard et al. (2017) (10/17)	Symptômes et imagerie	Flex, ext	Dynamomètre isocinétique (Humac Norm, CSMi, Stoughton, Massachusetts, USA)	CS	*Cross-sectional, comparative study*	60 atteints 60 sains	22H/38F 22H/38F	36.9 (9.0) 36.9 (9.0)	Flex 1.5 (0.7) Nm/kg Ext 2.5 (1.1) Nm/kg	Flex 1.6 (0.6) Nm/kg Ext 2.6 (0.9) Nm/kg	Flex -0.15 (-0.51; 0.21) Ext -0.10 (-0.53; 0.34)
Kilvian et al. (2016) (10/17)	Symptômes et signes cliniques	Flex, ext, abd, add, RI, RE	Dynamomètre manuel (Microfet 3, Hoggan Medical Industries, West Jordan, UT)	GC	*Quasi-experimental, cohort comparison*	15 CFA 13 GC	15F 13F	18.9 (1.3) 19.6 (1.4)	Flex 214 (42) N Ext 293 (58) N Abd 134 (42) N Add 121 (48) N RI 87 (26) N RE 99 (26) N	Flex 196 (29) N Ext 224 (55) N Abd 122 (24) N Add 115 (34) N RI 73 (22) N RE 89 (21) N	Flex -0.49 (-1.25; 0.26) Ext -1-19 (-2.00; -0.37) Abd -0.35 (-1.10; 0.40) Add -0.14 (-0.89; 0.60) RI -0.57 (-1.33; 0.19) RE -0.37 (-1.12; 0.38)
Konnaris et al. (2023) (10/17)	Symptômes, signes cliniques, imagerie	Flex, ext, abd	Dynamomètre (Biodex system 3)	CS	*Prospective cohort study*	17 atteints 17 sains	11F/6H 11F/6H	27.4 (7.3) 21.2 (6.3) 25.2 (7.4)	Flex 45° 184.21 (50) N Flex 90° 137.58 (20.38) N Ext 45° 248. 10 (55.70) N Ext 90° 246. 15 (51.28) N Abd 45° 100 (33.96) N	Flex 45° 189.47 (39.47) N Flex 90° 157.96 (33.12) N Ext 45° 258.23 (42.77) N Ext 90° 246,15 (53.85) N Abd 45° 109.43 (30.19) N	Flex 45° -0.11 (-0.79; 0.56) Flex 90° -0.72 (-1.42; -0.03) Ext 45° -0.20 (-0.88; 0.47) Ext 90° 0.00 (-0.67; 0.67) Abd 45° -0.27 (-0.95; 0.40)
Maffiuletti et al. (2020) (9/17)	Symptômes, signes cliniques, imagerie	Abd, add, RI, RE Flex, ext	Dynamomètre stabilisé (Nicholas Manual muscle Tester, Lafayette Inc., Lafayette, IN) Dynamomètre isocinétique (Biodex System 4, Biodex Medical Systems, Shirley, NY)	CS	*Cross-sectional study*	34 atteints 34 sains	13H/21F 13H/21F	H 26.0 (5.0) F 24.0 (5.0)	Flex 1.31 (0.38) Nm/kg Ext 2.24 (0.74) Nm/kg Abd 1.77 (0.44) Nm/kg Add 2.33 (0.65) Nm/kg RI 0.72 (0.30) Nm/kg RE 0.53 (0.21) Nm/kg	Flex 1.40 (0.39) Nm/kg Ext 2.33 (0.75) Nm/kg Abd 1.81 (0.42) Nm/kg Add 2.33 (0.63) Nm/kg RI 0.72 (0.27) Nm/kg RE 0.51 (0.20) Nm/kg	Flex -0.23 (-0.71; 0.25) Ext -0.12 (-0.60; 0.36) Abd -0.09 (-0.57; 0.38) Add 0.00 (-0.48; 0.48) RI 0.00 (-0.48 ;0.48) RE 0.10 (-0.38; 0.57)
Malloy et al. (2021) (10/17)	Symptômes, signes cliniques, imagerie	Flex, abd, RI, RE	Dynamomètre manuel (Lafayette Instrument Inc)	GC	*Controlled laboratory study*	34 CFA 26 GC	11F/23F 9F/17F	27.3 (7.0) 30.0 (7.0)	Flex 4.0 (1.1) N/kg Abd 2.9 (0.7) N/kg RI 0.8 (0.3) N/kg RE 1.0 (0.3) N/kg	Flex 4.8 (1.2) N/kg Abd 3.2 (0.5) N/kg RI 1.0 (0.3) N/kg RE 1.2 (0.3) N/kg	Flex -0.69 (-1.22; -0.16) Abd -0.48 (-0.99; 0.04) RI -0.66 (-1.18; -0.13) RE -0.66 (-1.18; -0.13)

Seijas-Vàzquez et al. (2020) (10/17)	Symptômes, signes cliniques, imagerie	Flex, ext, abd, add, RI, RE	Dynamomètre manuel (MicroFET2; Hoggan Health Industries, West Jordan, UT, USA)	CS	Case series	55 atteints 55 sains	33H/22F 33H/22F	40.80 (10.25)	Flex 93.66 (44.92) N Ext 103.00 (42.79) N Abd 109.04 (36.37) N Add 87.02 (32.51) N RI 91.74 (29.16) N RE 115.41 (48.79) N	Flex 112.85 (45.73) N Ext 108.02 (41.28) N Abd 118.13 (39.51) N Add 88.72 (35.00) N RI 92.74 (29.60) N RE 125.03 (50.12) N	Flex -0.42 (-0.80; -0.04) Ext -0.12 (-0.49; 0.26) Abd -0.24 (-0.61; 0.14) Add -0.05 (-0.42; 0.32) RI -0.03 (-0.41; 0.34) RE -0.19 (-0.57; 0.18)
Servant et al. (2022) (10/17)	Imagerie	Flex, ext, abd, add, RI, RE, quadriceps, IJ	Dynamomètre manuel (Hoggan MicroFET2, Scientific L.L.C., Calt Lake City, UT, USA)	CS	Retrospective Exploratory study	29 atteints 29 sains Pré-arthroscopie	7H/22F	27.4 (7.5)	Flex 1.88 (0.46) Nm/kg Ext 2.11 (0.60) Nm/kg Abd 1.97 (0.42) Nm/kg Add 1.81 (0.54) Nm/kg RI 1.13 (0.37) Nm/kg RE 1.17 (0.40) Nm/kg	Flex 1.95 (0.50) Nm/kg Ext 2.10 (0.53) Nm/kg Abd 1.98 (0.45) Nm/kg Add 1.90 (0.49) Nm/kg RI 1.14 (0.43) Nm/kg RE 1.21 (0.38) Nm/kg	Flex -0.14 (-0.66; 0.37) Ext 0.02 (-0.50; 0.53) Abd -0.02 (-0.54; 0.49) Add -0.17 (-0.69; 0.34) RI -0.02 (-0.54; 0.49) RE -0.10 (-0.62; 0.41)
Servant et al. (2022) (10/17)	Imagerie	Flex, ext, abd, add, RI, RE, quadriceps, IJ	Dynamomètre manuel (Hoggan MicroFET2, Scientific L.L.C., Calt Lake City, UT, USA)	CS	Retrospective Exploratory study	20 atteints 20 sains Pré-luxation	13H/7F	25.9 (6.5)	Flex 2.08 (0.75) Nm/kg Ext 2.28 (0.84) Nm/kg Abd 1.87 (0.49) Nm/kg Add 2.05 (0.68) Nm/kg RI 1.26 (0.38) Nm/kg RE 1.16 (0.42) Nm/kg	Flex 2.14 (0.70) Nm/kg Ext 2.31 (0.88) Nm/kg Abd 1.98 (0.51) Nm/kg Add 2.09 (0.71) Nm/kg RI 1.26 (0.43) Nm/kg RE 1.10 (0.36) Nm/kg	Flex -0.08 (-0.69; 0.52) Ext -0.03 (-0.64; 0.57) Abd -0.22 (-0.82; 0.39) Add -0.06 (-0.66; 0.55) RI 0.00 (-0.60; 0.60) RE 0.15 (-0.46; 0.76)
Wierks et al. (2021) (12/17)	Symptômes, signes cliniques, imagerie	Flex, ext, abd, add	Dynamomètre manuel	CS	Case control	98 atteints 98 sains (Extension : 97)	34H/64F	H 38.37 F 36.51	Flex 156 (41) N Ext 187 (53) N Abd 234 (61) N Add 187 (61) N	Flex 168 (35) N Ext 198 (50) N Abd 228 (58) N Add 195 (56) N	Flex -0.31 (-0.60; -0.03) Ext -0.21 (-0.49; 0.07) Abd 0.10 (-0.18; 0.38) Add -0.14 (-0.42; 0.14)

Abd, abduction ; Add, adduction ; CFA, conflit fémoro-acétabulaire ; CS, côté sain ; DMS, déviation moyenne standard ; DS, déviation standard ; Ext, extension; F, femme ; Flex, flexion ; GC, groupe contrôle ; H, homme ; IC, intervalle de confiance ; IJ, ischio-jambiers ; RI, rotation interne ; RE, rotation externe

3.3 Qualité des études incluses

Réalisée à l'aide de la *Downs and Black Checklist* modifiée selon Freke et al. (2016), l'évaluation de la qualité méthodologique des études incluses est visible dans le tableau 4. Les résultats détaillés correspondent à l'annexe II. Treize études présentent une qualité moyenne et sept études présentent une bonne qualité.

Tableau 4: Downs & Black Checklist modifiée

Study (year published)	Reporting (0-9)	External validity (0-3)	Internal validity (bias) (0-3)	Internal validity (confounding) (0-3)	Total score Out of 17	Total score %
Beck and al. (2020)	8	0	2	2	12	71 (Good)
Bizzini and al. (2023)	6	0	2	1	9	53 (Fair)
Brunner and al. (2015)	7	1	2	1	11	65 (Good)
Casartelli and al. (2011)	7	0	2	1	10	59 (Fair)
Catelli and al. (2018)	7	0	2	2	11	65 (Good)
Catelli and al. (2019)	6	0	2	1	9	53 (Fair)
Davis and al. (2016)	8	0	1	0	9	53 (Fair)
Diamond and al. (2015)	7	0	2	1	10	59 (Fair)
Erbert and al. (2023)	8	1	2	2	13	76 (Good)
Frasson and al. (2020)	7	0	2	2	11	65 (Good)
Gonçalves and al. (2023)	8	0	1	3	12	71 (Good)
Guenther and al. (2012)	7	0	1	1	9	53 (Fair)
Kierkegaard and al. (2017)	7	0	2	1	10	59 (Fair)
Kivlan and al. (2016)	7	0	2	1	10	59 (Fair)
Konnaris and al. (2023)	5	1	2	2	10	59 (Fair)
Maffiuletti and al. (2020)	6	0	2	1	9	53 (Fair)
Malloy and al. (2021)	7	0	2	1	10	59 (Fair)
Seijas-Vàzquez and al. (2020)	7	0	2	1	10	59 (Fair)
Servant and al. (2022)	7	0	2	1	10	59 (Fair)
Wierks and al. (2021)	8	0	2	2	12	71 (Good)

3.4 Données manquantes

Une demande de renseignement a été prise avec Nepple et al. (2015) afin d'intégrer l'étude : *Hip Strength Deficits in Patients with Symptomatic Femoroacetabular Impingement and Labral Tears* à notre revue systématique et méta-analyse. Malheureusement cette dernière n'a pas abouti.

3.5 Positions

Les études incluses utilisent des positions de tests différentes. Ces positions sont indiquées dans les diagrammes en forêt par des lettres mises en exposant. Les études sont ordonnées selon leurs positions afin de permettre une meilleure lecture.

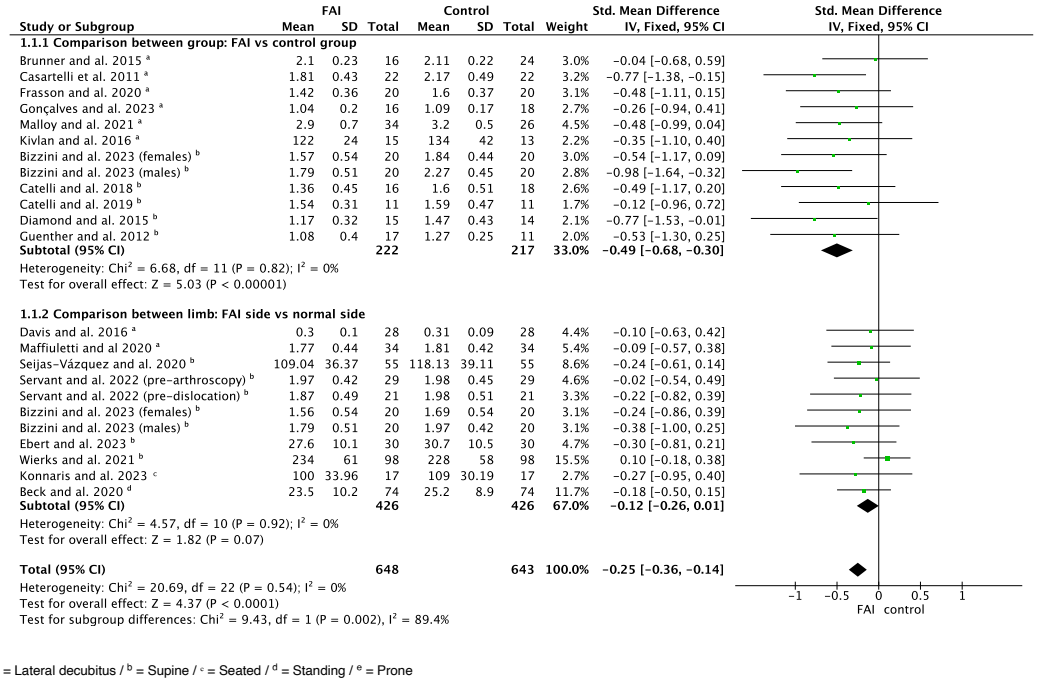
3.6 Résultats selon groupe musculaire

3.6.1 Abducteurs

La figure 4, partie 1.1.1, présente la différence de force musculaire en abduction entre des personnes atteintes d'un syndrome du CFA et un groupe contrôle. Onze études ont analysé cette composante de mouvement regroupant au total 222 personnes atteintes d'un syndrome du CFA et 217 personnes dans le groupe contrôle. L'étude de Bizzini et al. (2023) réalise deux comparaisons différentes, une première comprenant seulement des femmes et une deuxième seulement des hommes. L'EG s'élève à -0.49 [IC 95% -0.68 ; -0.30], en faveur du groupe CFA, démontrant une faiblesse musculaire dans ce groupe-ci. Cette valeur représente un effet faible selon Cohen (1988). Le résultat est statistiquement significatif (P < 0.00001). L'hétérogénéité est insignifiante (I^2=0%, Chi^2=6.68, p=0.82) selon le *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

La partie 1.1.2 expose la différence de force musculaire en abduction entre la hanche atteinte et la hanche saine chez une personne atteinte du syndrome du CFA. Neuf études ont analysé cette composante de mouvement regroupant au total 426 personnes. L'étude de Servant et al. (2022) sépare les personnes participantes en deux groupes, selon l'opération chirurgicale programmée (pré-arthroscopie et pré-luxation). L'étude de Bizzini et al. (2023) réalise à nouveau une comparaison comprenant uniquement les femmes et l'autre, uniquement les hommes. L'EG s'élève à -0.12 [IC 95% -0.26 ; 0.01], en faveur du côté atteint, démontrant une différence musculaire entre les deux côtés. Cette valeur représente un effet faible selon Cohen (1988). Le résultat est statistiquement non-significatif (P = 0.07). L'hétérogénéité est insignifiante (I^2=0%, Chi^2=4.57, p=0.92) selon le *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

Figure 4: Diagramme en forêt de différence de force isométrique en abduction entre une personne atteinte d'un syndrome du CFA, son côté sain et un groupe contrôle



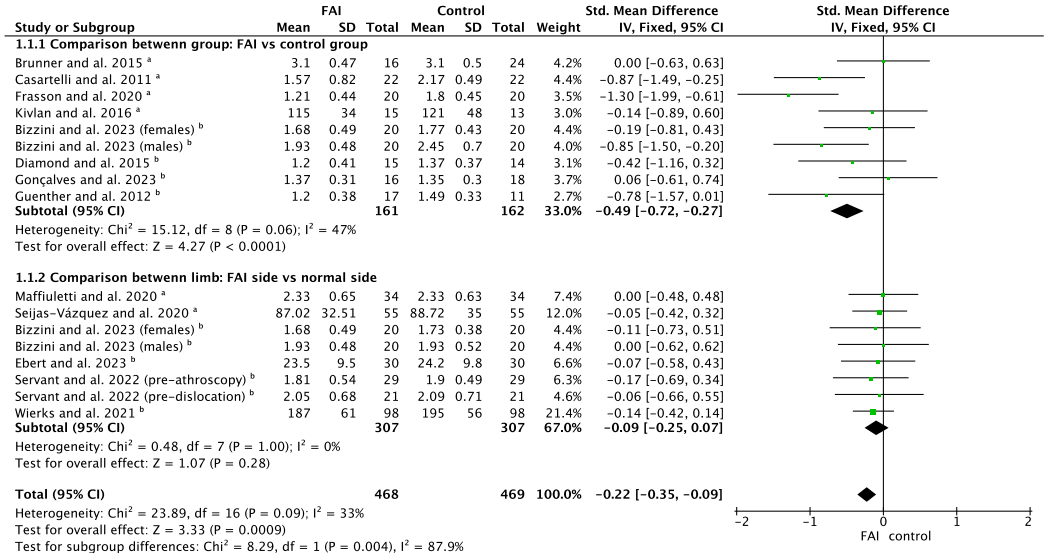
CI, confidence interval ; FAI, femoroacetabular impingement ; IV, inverse variance ; SD, standard deviation ; Std, Standard

3.6.2 Adducteurs

La figure 5, partie 1.1.1, présente la différence de force musculaire en adduction entre des personnes atteintes d'un syndrome du CFA et un groupe contrôle. Huit études ont analysé cette composante de mouvement regroupant au total 161 personnes atteintes d'un syndrome du CFA et 162 personnes dans le groupe contrôle. L'EG s'élève à -0.49 [IC 95% -0.72 ; -0.27], en faveur du groupe CFA, démontrant une faiblesse musculaire chez les personnes atteintes du syndrome du CFA. Cette valeur représente un effet faible selon Cohen (1988). Le résultat est statistiquement significatif (P < 0.0001). L'hétérogénéité est modérée (I^2=47%, Chi^2=15.12, *p*=0.06) selon le *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

La partie 1.1.2 montre la différence de force musculaire en adduction entre la hanche atteinte et la hanche saine chez une personne atteinte du syndrome du CFA. Six études ont analysé cette composante de mouvement regroupant au total 307 personnes. L'EG s'élève à -0.09 [IC 95% -0.25 ; 0.07], en faveur du côté atteint, démontrant une différence musculaire entre les deux côtés. Cette valeur représente un effet faible selon Cohen (1988). Le résultat est statistiquement non-significatif (P = 0.28). L'hétérogénéité est insignifiante (I^2=0%, Chi^2=0.48, *p*=1.00) selon le *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

Figure 5: Diagramme en forêt de différence de force isométrique en adduction entre une personne atteinte d'un syndrome du CFA, son côté sain et un groupe contrôle



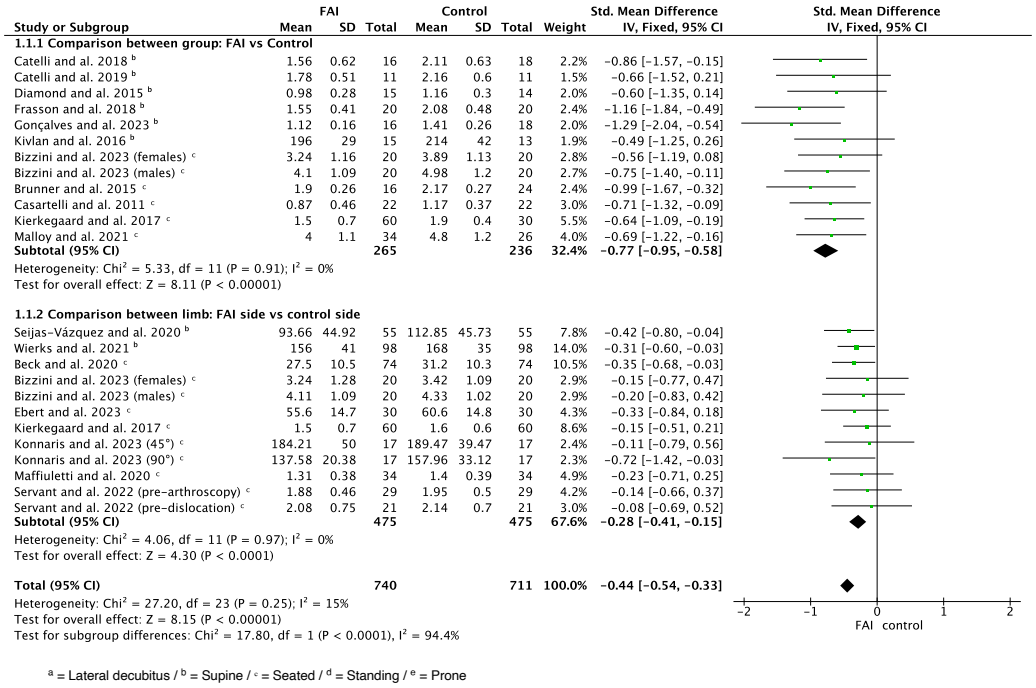
CI, confidence interval ; FAI, femoroacetabular impingement ; IV, inverse variance ; SD, standard deviation ; Std, Standard

3.6.3 Fléchisseurs

La figure 6, partie 1.1.1, présente la différence de force musculaire en flexion entre des personnes atteintes d'un syndrome du CFA et un groupe contrôle. Onze études ont analysé cette composante de mouvement regroupant au total 265 personnes atteintes d'un syndrome du CFA et 236 personnes dans le groupe contrôle. L'EG s'élève à -0.77 [IC 95% -0.95 ; -0.58], en faveur du groupe CFA, démontrant une faiblesse musculaire dans ce groupe-ci. Cette valeur représente un effet modéré selon Cohen (1988). Le résultat est statistiquement significatif (P < 0.00001). L'hétérogénéité est insignifiante (I^2=0%, Chi^2=5.33, *p*=0.91) selon le *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

La partie 1.1.2 montre la différence de force musculaire en flexion entre la hanche atteinte et la hanche saine chez une personne atteinte du syndrome du CFA. Neuf études ont analysé cette composante de mouvement regroupant au total 475 hanches. Le nombre de personnes s'élève en revanche à 458 car l'étude de Konnaris et al. (2023) réalise les mesures de la flexion à 90° et à 45° de flexion de hanche chez le même groupe. L'EG s'élève à -0.28 [IC 95% -0.41 ; 0.15], en faveur du côté atteint, démontrant une différence musculaire entre les deux côtés. Cette valeur représente un effet faible selon Cohen (1988). Le résultat est statistiquement non-significatif (P < 0.0001). L'hétérogénéité est insignifiante (I^2=0%, Chi^2=4.06, *p*=0.97) selon le *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

Figure 6: Diagramme en forêt de différence de force isométrique en flexion entre une personne atteinte d'un syndrome du CFA, son côté sain et un groupe contrôle



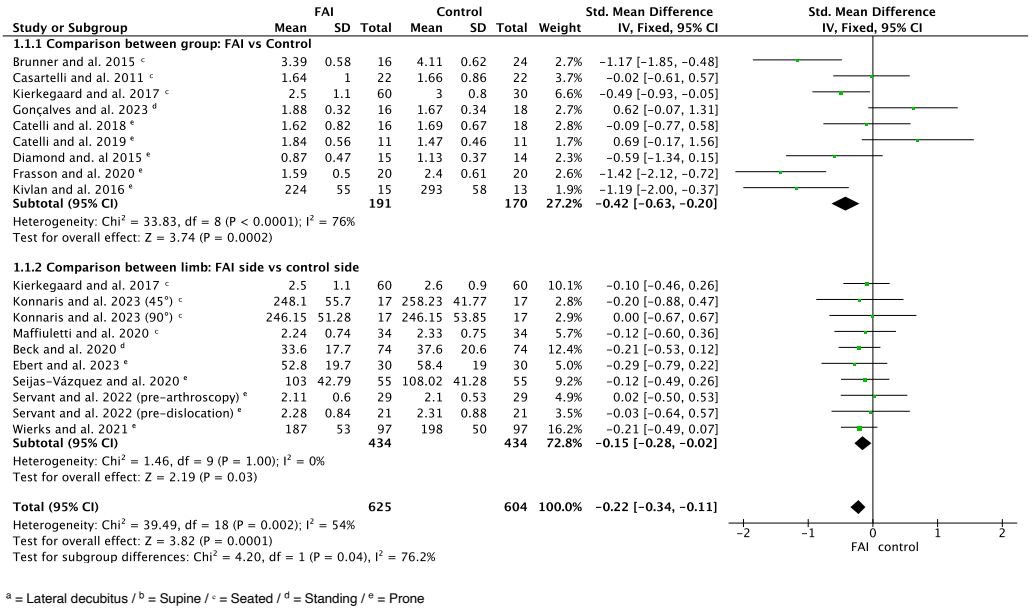
CI, confidence interval ; FAI, femoroacetabular impingement ; IV, inverse variance ; SD, standard deviation ; Std, Standard

3.6.4 Extenseurs

La figure 7, partie 1.1.1, présente la différence de force musculaire en extension entre des personnes atteintes d'un syndrome du CFA et un groupe contrôle. Neuf études ont analysé cette composante de mouvement regroupant au total 191 personnes atteintes d'un syndrome du CFA et 170 personnes dans le groupe contrôle. L'EG s'élève à -0.42 [IC 95% -0.63 ; -0.20], en faveur du groupe CFA, démontrant une faiblesse musculaire dans ce groupe-ci. Cette valeur représente un effet faible selon Cohen (1988). Le résultat est statistiquement significatif (P = 0.0002). L'hétérogénéité est considérable (I^2=76%, Chi^2=33.83, *p*=<0.0001) selon le *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

La partie 1.1.2 montre la différence de force musculaire en extension entre la hanche atteinte et la hanche saine chez une personne atteinte du syndrome du CFA. Huit études ont analysé cette composante de mouvement regroupant au total 417 personnes. L'EG s'élève à -0.15 [IC 95% -0.28 ; 0.02], en faveur du côté atteint, démontrant une différence musculaire entre les deux côtés. Cette valeur représente un effet faible selon Cohen (1988). Le résultat est statistiquement non-significatif (P = 0.03). L'hétérogénéité est insignifiante (I^2=0%, Chi^2=1.46, *p*=1.00) selon le *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

Figure 7: Diagramme en forêt de différence de force isométrique en extension entre une personne atteinte d'un syndrome du CFA, son côté sain et un groupe contrôle



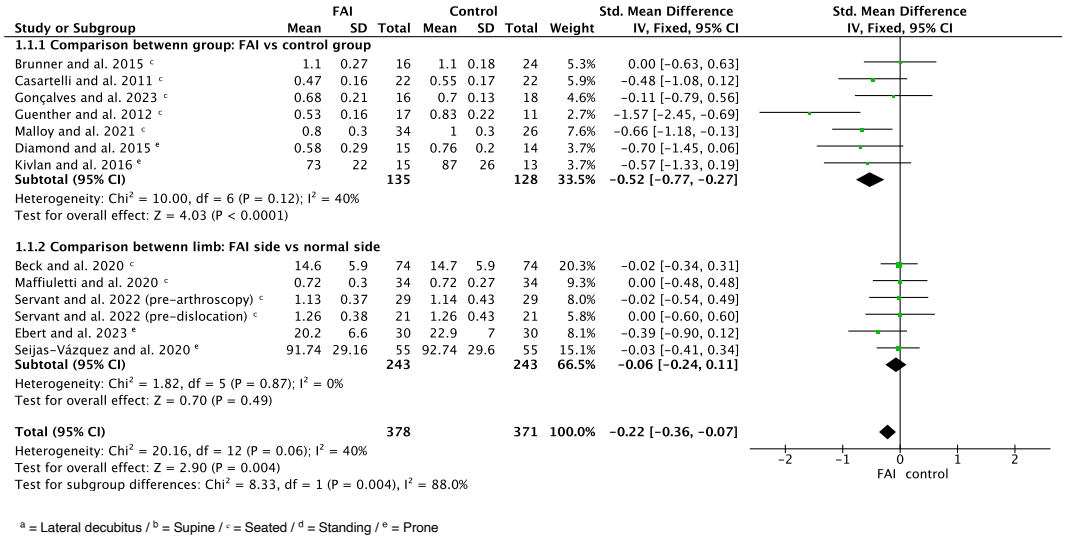
CI, confidence interval ; FAI, femoroacetabular impingement ; IV, inverse variance ; SD, standard deviation ; Std, Standard

3.6.5 Rotateurs internes

La figure 8, partie 1.1.1, présente la différence de force musculaire en rotation interne entre des personnes atteintes d'un syndrome du CFA et un groupe contrôle. Sept études ont analysé cette composante de mouvement regroupant au total 135 personnes atteintes d'un syndrome du CFA et 128 personnes dans le groupe contrôle. L'EG s'élève à -0.52 [IC 95% -0.77 ; -0.27], en faveur du groupe CFA, démontrant une faiblesse musculaire dans ce groupe-ci. Cette valeur représente un effet modéré selon Cohen (1988). Le résultat est statistiquement significatif (P < 0.0001). L'hétérogénéité est modérée (I^2=40%, Chi^2=10.00, *p*=0.12) selon le *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

La partie 1.1.2 montre la différence de force musculaire en rotation interne entre la hanche atteinte et la hanche saine chez une personne atteinte du syndrome du CFA. Cinq études ont analysé cette composante de mouvement regroupant au total 243 personnes. L'EG s'élève à -0.06 [IC 95% -0.24 ; 0.11], en faveur du côté atteint, démontrant une différence musculaire entre les deux côtés. Cette valeur représente un effet faible selon Cohen (1988). Le résultat est statistiquement non-significatif (P = 0.49). L'hétérogénéité est insignifiante (I^2=0%, Chi^2=1.82, *p*=0.87) selon le *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

Figure 8: Diagramme en forêt de différence de force isométrique en rotation interne entre une personne atteinte d'un syndrome du CFA, son côté sain et un groupe contrôle



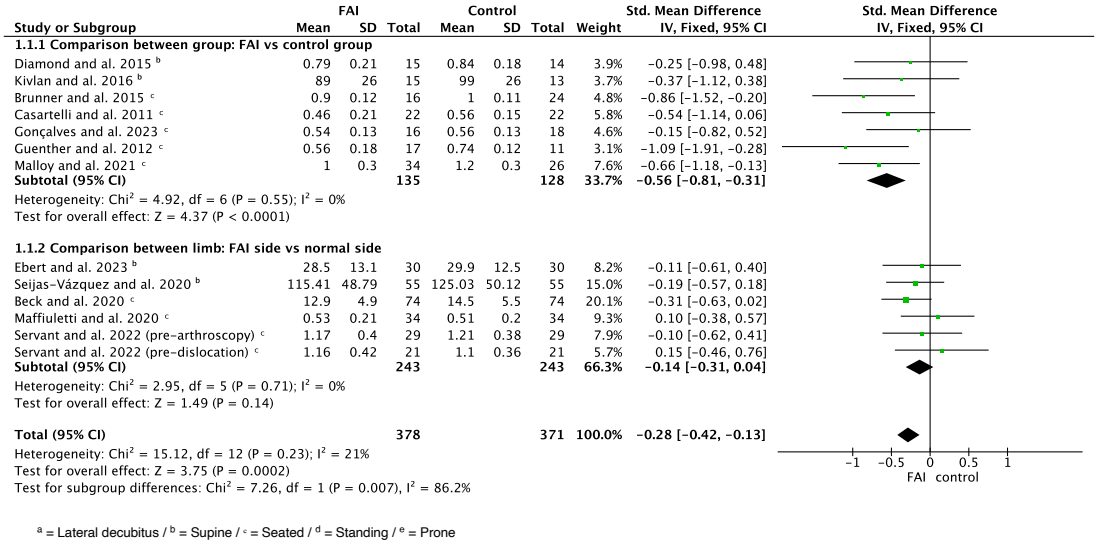
CI, confidence interval ; FAI, femoroacetabular impingement ; IV, inverse variance ; SD, standard deviation ; Std, Standard

3.6.6 Rotateurs externes

La figure 9, partie 1.1.1, présente la différence de force musculaire en rotation externe entre des personnes atteintes d'un syndrome du CFA et un groupe contrôle. Sept études ont analysé cette composante de mouvement regroupant au total 135 personnes atteintes d'un syndrome du CFA et 128 personnes dans le groupe contrôle. L'EG s'élève à -0.56 [IC 95% -0.81 ; -0.31], en faveur du groupe CFA, démontrant une faiblesse musculaire dans ce groupe-ci. Cette valeur représente un effet modéré selon Cohen (1988). Le résultat est statistiquement significatif (P < 0.0001). L'hétérogénéité est insignifiante (I^2=0%, Chi^2=4.92, *p*=0.55) selon le *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

La partie 1.1.2 montre la différence de force musculaire en rotation externe entre la hanche atteinte et la hanche saine chez une personne atteinte du syndrome du CFA. Cinq études ont analysé cette composante de mouvement regroupant au total 243 personnes. L'EG s'élève à -0.14 [IC 95% -0.31 ; 0.04], en faveur du côté atteint, démontrant une différence musculaire entre les deux côtés. Cette valeur représente un effet faible selon Cohen (1988). Le résultat est statistiquement non-significatif (P = 0.14). L'hétérogénéité est insignifiante (I^2=0%, Chi^2=2.95, *p*=0.71) selon le *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

Figure 9: Diagramme en forêt de différence de force isométrique en rotation externe entre une personne atteinte d'un syndrome du CFA, son côté sain et un groupe contrôle



CI, confidence interval ; FAI, femoroacetabular impingement ; IV, inverse variance ; SD, standard deviation ; Std, Standard

3.7 Résumé des résultats

La tableau 5 présente une synthèse des résultats statistiques des différents graphiques en forêt. Les fléchisseurs montrent la plus grande différence statistique pour les deux comparaisons.

Tableau 5: Récapitulatif des résultats statistiques des diagrammes en forêt

	Effet global	Valeur – P	Hétérogénéité (%)
Abduction			
CFA - GC	-0.49 en faveur du groupe CFA	<0.00001	0% (insignifiante)
CFA - CS	-0.12 en faveur du groupe CFA	0.07	0% (insignifiante)
Adduction			
CFA - GC	-0.49 en faveur du groupe CFA	<0.0001	47% (modérée)
CFA - CS	-0.09 en faveur du groupe CFA	0.28	0% (insignifiante)
Flexion			
CFA - GC	-0.77 en faveur du groupe CFA	<0.00001	0% (insignifiante)
CFA - CS	-0.28 en faveur du groupe CFA	<0.0001	0% (insignifiante)
Extension			
CFA - GC	-0.42 en faveur du groupe CFA	0.0002	76% (considérable)
CFA - CS	-0.15 en faveur du groupe CFA	0.03	0% (insignifiante)
Rotation interne			
CFA - GC	-0.52 en faveur du groupe CFA	0.0001	40% (modérée)
CFA - CS	-0.06 en faveur du groupe CFA	0.49	0% (insignifiante)
Rotation externe			
CFA - GS	-0.56 en faveur du groupe CFA	<0.0001	0% (insignifiante)
CFA - CS	-0.14 en faveur du groupe CFA	0.14	0% (insignifiante)

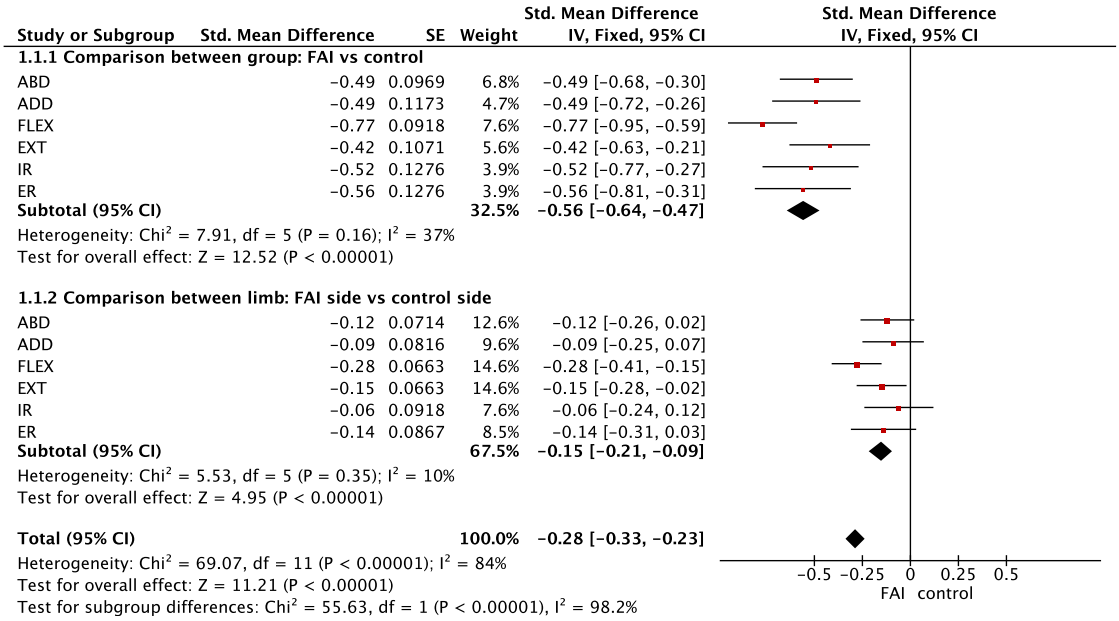
CFA, conflit fémoro-acétabulaire ; CS, côté sain ; GC, groupe contrôle

3.8 Résultats globaux

La figure 10 ci-dessous affiche un résumé des résultats, représentant la DSM de chacun des mouvements examinés dans cette étude. La partie 1.1.1 s'intéresse à la comparaison entre des personnes atteintes d'un syndrome du CFA et un groupe contrôle. L'EG s'élève à -0.56 [IC 95% -0.64 ; -0.47], en faveur du groupe CFA, démontrant une faiblesse musculaire dans ce groupe-ci. Cette valeur représente un effet modéré selon Cohen (1988). Le résultat est statistiquement significatif (P < 0.00001). L'hétérogénéité est faible (I^2=37%, Chi^2=7.91, *p*=0.16) selon le *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

La partie 1.1.2 présente une comparaison entre la hanche atteinte et la hanche saine chez une personne atteinte du syndrome du CFA. L'EG s'élève à -0.15 [IC 95% -0.21 ; -0.09], en faveur du groupe CFA, démontrant une faiblesse musculaire dans ce groupe-ci. Cette valeur représente un effet modéré selon Cohen (1988). Le résultat est statistiquement significatif (P < 0.00001). L'hétérogénéité est faible (I^2=10%, Chi^2=5.53, *p*=0.35) selon le *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins & Thomas, 2019).

Figure 10: Diagramme en forêt de différence de force isométrique dans toutes les composantes de mouvement entre une personne atteinte d'un syndrome du CFA, son côté sain et un groupe contrôle



ABD, abduction ; ADD, adduction ; CI, confidence interval ; ER, external rotation ; EXT, extension ; FLEX, flexion ; IR, internal rotation ; FAI, femoroacetabular impingement ; IV, inverse variance ; SD, standard deviation ; Std, Standard

4 Discussion

4.1 Synthèse des résultats

Cette revue systématique et méta-analyse a pour objectif d'identifier les différences de force isométrique maximale des muscles de la hanche chez les personnes présentant un syndrome du CFA, comparé à un groupe contrôle ou au côté sain. Les groupes musculaires étudiés sont les abducteurs, les adducteurs, les fléchisseurs, les extenseurs, les rotateurs internes et les rotateurs externes de hanche. Cette présente étude montre une diminution statistiquement significative de la force musculaire en isométrique chez les personnes atteintes d'un syndrome du CFA en comparaison avec un groupe contrôle, cela dans tous les groupes musculaires étudiés. Lors de la comparaison entre le côté atteint et le côté sain d'une personne atteinte d'un syndrome du CFA, une différence statistiquement significative est présente au niveau des fléchisseurs de hanche. Les groupes musculaires participant à l'extension, l'abduction, l'adduction, la rotation interne et externe montrent une faiblesse mais non statistiquement significative.

4.2 Qualité des études

Un tiers des études analysées dans cette revue et méta-analyse sont de bonne qualité. Les deux tiers restants s'avèrent de qualité moyenne. Toutes ont été prises en compte pour la réalisation de ce travail. La qualité moyenne est majoritairement justifiée par la présence de deux items analysant la qualité du follow-up. Plusieurs études n'ayant pas de follow-up, comme Bizzini et al. (2023), Brunner et al. (2015), Catelli et al. (2018), Catelli et al. (2019), Casartelli et al. (2011), Diamond et al. (2015), Frasson et al. (2020), Guenther et al. (2012), Kierkegaard et al. (2017), Kivlan et al. (2016), Konnaris et al. (2023), Mafiuletti et al. (2007), Malloy et al. (2021), Seijas-Vàzquez et al. (2020) ainsi que Servant et al. (2022) n'ont pas obtenu ces deux points. Ces deux points n'ont pas d'impact au niveau de la qualité de cette présente étude, car elle ne s'intéresse pas au follow-up, mais uniquement à des valeurs avant une quelconque intervention.

4.3 Interprétation des résultats

4.3.1 Groupe contrôle vs côté sain

Les auteures ont pris le parti d'inclure des études comparant la force au côté sain et/ou au groupe contrôle. Les résultats ont été séparés par deux sous-groupes dans les diagrammes en forêt pour permettre une comparaison plus significative et une meilleure lecture. L'EG

de chaque sous-groupe a été interprété dans les résultats de cette méta-analyse. Pour toutes les composantes de mouvement, la comparaison avec un groupe contrôle a montré des différences plus significatives que la comparaison avec le côté sain. Comme mentionné plus haut, une différence significative est mise en évidence dans toutes les composantes de mouvement lorsque la comparaison est effectuée avec le groupe contrôle, mais uniquement présente pour les fléchisseurs lorsque la comparaison est faite avec le côté sain. L'EG total du diagramme en forêt montre le résultat pour toutes les études, sans distinction entre les deux comparaisons. Il affiche également une différence significative dans toutes les composantes de mouvement.

4.3.2 Positions

Pour le test de l'abduction, quatre positions ont été définies : décubitus latéral, décubitus dorsal, assis et debout. La position assise est utilisée uniquement dans l'étude de Konnaris et al. (2023) et la position debout est appliquée uniquement dans l'étude de Beck et al. (2020). Aucune conclusion ne peut être tirée de ces positions. Les positions en décubitus latéral et dorsal montrent des résultats homogènes. Le test de force des adducteurs a été réalisé dans deux positions différentes : décubitus latéral et décubitus dorsal. Lorsque la comparaison est réalisée avec le groupe contrôle, les résultats de la position décubitus dorsal montrent une meilleure homogénéité que ceux réalisés en position de décubitus latéral. Lorsque la comparaison est faite avec le côté sain, les deux positions différentes présentent des résultats homogènes. Pour les tests de flexion et d'extension, les positions utilisées sont : assis, debout et décubitus ventral. Seules les études de Beck et al. (2020) et Gonçalves et al. (2023) utilisent la position debout. Elles n'ont cependant pas la même comparaison, ce qui ne permet pas de tirer une conclusion sur cette position. Le test en position de décubitus ventral rapporte des résultats avec une plus grande hétérogénéité que celui en position assise. Le test de force des rotateurs internes présente deux positions différentes : assis et décubitus ventral. Une légère différence peut être observée, montrant une faiblesse moins marquée, mais qui n'est pas pour autant significative, pour les hanches testées dans la position assise. A l'exception, l'étude de Guenther et al. (2012) testant également en position assise, expose des résultats avec la faiblesse la plus marquée. Également deux positions différentes sont utilisées pour les rotateurs externes : décubitus dorsal et assis. Les études utilisant la position de décubitus dorsal dévoilent des résultats avec une meilleure homogénéité.

4.3.3 Outils de mesures

Des outils de mesures différents sont employés dans les études incluses. La majorité des études utilise des dynamomètres manuels validés de marques différentes. Brunner et al. (2015), Casartelli et al. (2011), Kierkegaard et al. (2017) et Maffiuletti et al. (2020) emploient, pour les mouvements de flexion et d'extension, des dynamomètres isocinétiques. Aucune valeur mesurée avec le dynamomètre isocinétique montre des résultats sortant de la norme. Finalement, deux études, celle de Davis et al. (2016) et de Gonçalves et al. (2023) utilisent des dynamomètres customisés. Davis et al. (2016) mesurent uniquement l'abduction et les valeurs montrent une homogénéité avec les autres études. Tout comme les valeurs pour l'abduction et la rotation interne chez Gonçalves et al. (2023), restent également homogènes avec les autres études. En revanche, pour l'adduction mesurée par Gonçalves et al. (2023), les résultats indiquent que le groupe contrôle est atteint d'une plus grande faiblesse que le groupe CFA. C'est la seule étude en faveur du groupe contrôle pour cette composante de mouvement. La flexion et l'extension montrent également des résultats en faveur du groupe contrôle. Ces résultats ne sont pas discordants pour autant, puisque l'étude de Catelli et al. (2019), pour la flexion, et l'étude Diamond et al. (2015), pour l'extension, affichent des résultats semblables. Finalement, la rotation externe, mesurée par Gonçalves et al. (2023) et comparée à un groupe contrôle, est la valeur qui présente la DMS la plus faible.

4.3.4 Make et *break test*

Certaines études indiquent clairement avoir suivi des directives en matière de dynamométrie, ce qui confirme la réalisation d'un *make test*. D'autres études ont exposé leurs procédés à travers des photos ou des images, permettant la déduction d'un *make test* également. Les dernières études ne possédaient aucune description explicite de la réalisation du test de force au dynamomètre. Il n'est cependant jamais indiqué si la résistance de l'examinateur a été exercée jusqu'à rompre la force du participant, technique qui décrirait alors un *break test*. On peut donc conclure, de manière incertaine, sur l'intégrité de test réalisé sous forme de *make test*. Cette incertitude ne permet pas d'introduire ces caractéristiques dans les résultats.

4.3.5 Composantes de mouvement

Le parti a été pris de comparer uniquement les mouvements simples des groupes musculaires participant au mouvement de la hanche. Il y a 19 études qui évaluent

l'abduction, 13 l'adduction, 18 la flexion, 16 l'extension et 12 la rotation interne et externe. De ce fait, la composante de mouvement complexe : flexion + abduction, qui figurait dans deux études, n'a pas été prise en compte (Catelli et al., 2018, 2019). De même, la force des extenseurs et fléchisseurs du genou, également mesurée dans deux études (Catelli et al., 2018; Servant et al., 2022), n'est pas retenue dans cette revue systématique avec méta-analyse.

4.4 Comparaison avec la littérature

Plusieurs revues systématiques s'intéressent aux différences de force musculaire isométrique chez les personnes présentant un syndrome du CFA et d'autres pathologies de la hanche. Premièrement, la revue systématique de Diamond et al. (2015), traitant des déficiences physiques et des limitations d'activités chez des personnes présentant un syndrome du CFA, rapporte une diminution significative de force musculaire dans les fléchisseurs et les adducteurs de hanche par rapport à un groupe contrôle. Diamond et al. (2015) s'appuient uniquement sur l'étude de Casartelli et al. (2011) pour cette partie de la revue systématique. Deuxièmement, le travail réalisé par Freke et al. (2016) s'intéresse à la différence musculaire entre les personnes atteintes d'une pathologie de la hanche et un groupe contrôle. La seule étude traitant uniquement des différences musculaires chez les personnes présentant un syndrome du CFA est également celle de Casartelli et al. (2011). La revue systématique rapporte des résultats aspécifiques au CFA. Elle démontre toutefois une faiblesse musculaire dans le groupe CFA pour les fléchisseurs de hanche, les rotateurs externes ainsi que pour les adducteurs. Une différence limitée et conflictuelle montre également une faiblesse dans les extenseurs et abducteurs de hanche. Troisièmement, Mayne et al. (2017) ont réalisé une revue systématique sur les différences de force musculaire en isométrique chez les personnes atteintes d'une pathologie de la hanche, dont le syndrome du CFA. L'analyse pour la force musculaire spécifique aux personnes présentant un syndrome du CFA comporte seulement l'article de Casartelli et al. (2011) qui démontre une faiblesse musculaire significative, excepté pour l'extension et la rotation interne.

L'étude de Casartelli et al. (2011), reprise dans les trois revues systématiques citées ci-dessus, compare la force musculaire en isométrique entre un groupe atteint d'un syndrome du CFA et un groupe contrôle. Cette étude est par ailleurs incluse dans la présente revue systématique et méta-analyse. Les résultats de Casartelli et al. (2011) sont statistiquement significatifs pour les mouvements d'adduction, de flexion, de rotation interne et

d'abduction. Ainsi, la prise en compte de plusieurs études traitant uniquement du syndrome du CFA permet de démontrer des différences significatives de force, également pour les mouvements d'extension et de rotation interne.

L'étude d'Arokoski et al. (2002) comparent des hanches arthrosiques aux hanches saines d'un groupe contrôle. Les résultats sont statistiquement significatifs pour les mouvements d'abduction, d'adduction et de flexion. L'extension ne montre pas de différence significative et les rotations n'ont pas été testées dans cette étude. L'étude de Rasch et al. (2007) compare le membre atteint et le membre sain des personnes atteintes d'arthrose de hanche. Les mouvements de flexion et d'extension exposent une différence statistiquement significative. L'adduction et l'abduction n'affichent pas de différence significative et les rotations n'ont pas été testées dans cette étude. Les hanches arthrosiques montrent donc des différences de force significatives, tout comme les hanches atteintes d'un CFA. Il serait intéressant d'explorer la force des hanches arthrosiques pour les mouvements de rotations.

Dans leur étude, Harris-Hayes et al. (2014) comparent des hanches souffrant de douleurs chroniques et des hanches saines. Lors de la comparaison avec un groupe contrôle, les hanches atteintes étaient significativement plus faibles pour les mouvements d'abduction et de rotation interne et externe. Les autres composantes de mouvement n'ont pas été testées. Lors de la comparaison avec le côté sain, l'abduction démontre un résultat statistiquement significatif, ainsi que la rotation externe à zéro degré de flexion de hanche. La rotation interne et la rotation externe à 90 degrés de flexion de hanche présentent une faiblesse mais non statistiquement significative.

4.5 Forces et limites

4.5.1 Forces

Cette méta-analyse et revue systématique affichent plusieurs forces. En premier lieu, les articles inclus sont récents, datant de 2011 à 2023, ce qui assure des données actuelles. Deuxièmement, les recherches dans les différentes bases de données ont débouché sur un nombre important d'articles, dont une sélection finale de 20 articles et un total de 1'450 hanches testées. Ensuite, les critères d'inclusions et d'exclusions ont été appliqués de manière stricte permettant de garantir une homogénéité entre les études sélectionnées par rapport aux différents critères. Le triage et l'éligibilité des articles ont été réalisés en double aveugle, évitant ainsi des influences réciproques. De plus, il existe actuellement, selon les recherches effectuées, seulement trois revues systématiques traitant des

différences musculaires dans le cadre de pathologies de la hanche dont le CFA. Ces dernières analysent une seule et même étude spécifique aux faiblesses musculaires dans le cadre du syndrome du CFA. Ce travail est innovant. Chaque composante de mouvement a été traitée de manière quantitative, regroupant au minimum cinq études pour une comparaison. Cette revue systématique et méta-analyse enrichit et actualise la littérature scientifique au sujet des faiblesses musculaires chez les personnes présentant un syndrome du CFA. Par ailleurs, l'implication personnelle et régulière des auteures ainsi que l'organisation rigoureuse leur a permis d'atteindre les objectifs de manière efficace pour la réalisation de ce travail. Pour terminer, la réalisation de cette méta-analyse a donné l'occasion aux auteures d'approfondir leurs connaissances sur le sujet du CFA ainsi que sur la réalisation d'un travail scientifique avec analyses de graphiques scientifiques.

4.5.2 Limites

Plusieurs limitations ont été identifiées lors de la réalisation de ce travail de Bachelor. La première réside dans l'hétérogénéité des tests musculaires. Comme décrit plus haut, les études utilisent des positions et des outils de mesure différents. Une autre réside dans la qualité de la méthodologie des études incluses. Deux tiers des études sont de qualité moyenne. Une autre limitation concerne l'utilisation de *WebPlotDigitizer* (Rohatgi, 2022) pour les études de Bizzini et al. (2023), Brunner et al. (2015), Gonçalves et al. (2023) et Konnaris et al. (2023). L'extraction des données présentes sous forme de graphique a donc été analysée par ce biais, ce qui a pu induire une légère perte de précision des données. De plus, l'extraction des données n'a pas été réalisée en double aveugle. Cela aurait permis une meilleure analyse de chaque item.

Finalement, la maîtrise limitée des logiciels *Zotero* (Takats et al., 2023), *Rayyan* (Ouzzani et al., 2016) et *RevMan* (The Cochrane Collaboration, 2020) a amené les auteures à plusieurs erreurs de manipulation qui ont obligé l'adaptation du travail en conséquence. Cela a nécessité beaucoup de temps et de ressources extérieures pour une compréhension permettant une bonne utilisation de ces logiciels.

4.6 Implication pour la pratique et la recherche

Les résultats de cette méta-analyse démontrent une faiblesse musculaire significative des muscles de la hanche dans toutes les directions en comparaison avec un groupe contrôle. En revanche, lorsque l'on compare le côté sain et le côté atteint d'un syndrome du CFA, seuls les fléchisseurs montrent une faiblesse musculaire significative. Ces résultats

montrent qu'un renforcement des fléchisseurs parait indispensable dans un traitement, qu'il soit préopératoire, conservateur ou post-opératoire. L'identification de ces déficits pourrait permettre une rééducation ciblée des zones affaiblies et de meilleurs résultats thérapeutiques.

L'étude de Casartelli et al. (2019) relève qu'un traitement physiothérapique incluant des exercices de renforcement musculaire, de stabilité du tronc et de stabilité de la hanche, permet d'obtenir une amélioration de la force de tous les groupes musculaires après 12 semaines de traitement. Plus particulièrement, les rotateurs internes et externes ainsi que les fléchisseurs ont montré une augmentation significative de la force. Selon l'étude de Casartelli et al. (2019), cette augmentation de force est en corrélation avec une amélioration des symptômes chez la moitié des personnes participant à l'étude. La même constatation apparaît chez Kemp et al. (2018). Ils ont évalué l'efficacité d'un traitement physiothérapique comme intervention spécifique au CFA. Ce traitement comprenait de la thérapie manuelle, du renforcement musculaire au niveau de la hanche et du tronc et de l'éducation thérapeutique. Leur conclusion montre un effet positif sur la force des adducteurs de la hanche, la réduction de la douleur et l'amélioration de la fonction (Kemp et al., 2018). Néanmoins, d'autres études doivent être réalisées pour prouver que les diminutions des douleurs et l'amélioration de la qualité de vie sont associées à des gains de force musculaire.

La méta-analyse de Zhu et al. (2022) comparant l'effet d'un traitement chirurgical par arthroscopie et d'un traitement conservateur montre que les deux traitements amènent une amélioration. Cependant, le traitement chirurgical est statistiquement supérieur sur le court et long terme. Pour Zhu et al. (2022), les résultats sont visibles plus rapidement après une arthroscopie. L'étude de Beck et al. (2020) expose une corrélation entre la force musculaire des fléchisseurs de hanche en préopératoire et les résultats à court terme en post-opératoire. Celle-là permet, selon Beck et al. (2020), d'identifier les personnes à risque d'obtenir de moins bons résultats en post-opératoire. Il serait intéressant d'investiguer de manière plus précise ces résultats et d'élaborer un protocole de traitement préopératoire en conséquence.

Actuellement, il n'existe pas de protocole standardisé décrit pour l'évaluation de la force musculaire. Ainsi, plusieurs stratégies de tests musculaires ont été utilisées dans les différentes études incluses, ce qui rend les comparaisons parfois abstraites. Les futures études doivent s'intéresser à l'isolement de chaque variable, afin de les comparer de manière spécifique. De plus, ce présent travail s'intéresse seulement aux différences de

la force isométrique. Il serait intéressant d'analyser, de manière systématique, les autres types de forces ainsi que la fatigabilité des muscles de la hanche dans le cadre du syndrome du CFA. Cela permettrait d'avoir une vision plus précise de l'impact de cette pathologie sur la musculature. Dans l'idéal, le développement d'un programme de physiothérapie spécifique, en comparaison avec une intervention chirurgicale, devrait être évalué.

Finalement l'étude de Heales et al. (2014) investigue les déficits sensori-moteurs du côté non atteint. Ils spéculent que les déficits du système nociceptif pourraient être expliqués par des anomalies du traitement central de douleur. Cela indiquerait une raison de la différence des résultats entre la comparaison avec le groupe contrôle et la comparaison avec le côté sain. Ils concluent que la comparaison avec le côté sain ne peut être utilisée comme norme de référence. De plus, nous pouvons également attester que la comparaison avec le côté sain ne prend pas en compte le côté dominant et non-dominant (Nepple et al., 2015). La méta-analyse de Heales et al. (2014) se penche sur les pathologies des tendons et il serait intéressant de confirmer cette hypothèse pour les diverses pathologies affectant la hanche, dont le syndrome du CFA. Actuellement, aucune revue systématique n'analyse ces particularités musculaires.

Conclusion

Cette revue systématique avec méta-analyse a permis de mettre en lumière une différence significative de la force musculaire isométrique des fléchisseurs, extenseurs, abducteurs, adducteurs, rotateurs internes et externes entre les personnes atteintes d'un syndrome du CFA et un groupe contrôle. Cette différence musculaire est aussi visible de manière significative entre le côté atteint et le côté sain de personnes présentant un syndrome du CFA au niveau des fléchisseurs de hanche.

Ces résultats émettent l'idée qu'un renforcement spécifique de ces zones musculaires peut avoir un effet positif chez les personnes souffrant d'un syndrome du CFA. D'autres études doivent être menées pour confirmer cette hypothèse.

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Liste des illustrations

Liste des tableaux

Liste des annexes

Annexes

Annexe I: Équation de recherche

Cochrane (367)

ID Search Hits
#1 MeSH descriptor: [Femoracetabular Impingement] this term only 134
#2 ("femoro-acetabular impingement" OR "fai" OR "hip impingement" OR "symptomatic FAI" OR "Pincer FAI" OR "CAM FAI" OR "femoroacetabular syndrom" OR "FAIS"):ti,ab,kw (Word variations have been searched) 523
#3 #1 OR #2 575
#4 MeSH descriptor: [Muscle Strength] this term only 6754
#5 MeSH descriptor: [Muscle Strength Dynamometer] this term only 272
#6 ("muscle activity" OR "muscle strength" OR "muscle weakness" OR "Paresis" OR "muscular paresis" OR "muscle modification" OR "muscle fatigue" OR "muscle contraction" OR "contraction" OR "hip muscles"):ti,ab,kw (Word variations have been searched) 46747
#7 ("isometric strength" OR "muscle ration" OR "iliocapsularis muscle" OR "hip strength" OR "hip muscle weakness" OR "muscle dynamometer" OR "dynamometer" OR " handheld dynamometer"):ti,ab,kw (Word variations have been searched) 5117
#8 ("groin" OR "neuromuscular function" OR "rate of force development" OR "muscle function" OR "weakness" OR "fragility" OR "muscle strength dynamometer" OR "strength isometric" OR "isometric contraction" OR "isometric" OR "hip muscle volume"):ti,ab,kw (Word variations have been searched) 33040
#9 ("dynamometer" OR "measurement" OR "maximal voluntary contraction" OR "strength testing" OR "strength imbalance" OR "strength deficit" OR "strength difference" OR "Ratio" OR "Strength measurement" OR "agonist" OR "antagonist"):ti,ab,kw (Word variations have been searched) 746160
#10 ("hip adductor strength" OR "hip abductor strength" OR "hip flexor strength" OR "hip rotator strength"):ti,ab,kw (Word variations have been searched) 97
#11 #4 OR #5 6865
#12 #11 OR #6 46747
#13 #12 OR #7 OR #8 OR #9 OR #10 777547
#14 #12 OR #13 777547
#15 #14 AND #3 367

Embase (956)

('femoroacetabular impingement'/exp OR 'femoroacetabular impingement' OR 'hip microinstability'/exp OR 'hip microinstability' OR 'symptomatic fai' OR 'hip impingement'/exp OR 'hip impingement' OR 'cam syndrome' OR 'pincer syndrome') AND ('muscle'/exp OR muscle OR 'muscle strength'/exp OR 'muscle strength' OR 'muscle weakness'/exp OR 'muscle weakness' OR 'paresis'/exp OR paresis OR 'muscle fatigue'/exp OR 'muscle fatigue' OR 'muscle contraction'/exp OR 'muscle contraction' OR 'contraction'/exp OR contraction OR 'hip muscle'/exp OR 'hip muscle' OR 'strength'/exp OR strength OR 'isometric strength'/exp OR 'isometric strength' OR 'muscle ratio' OR 'iliocapsularis muscle'/exp OR 'iliocapsularis muscle' OR 'hip strength'/exp OR 'hip strength' OR 'hip muscle weakness' OR 'dynamometry'/exp OR dynamometry OR 'handheld dynamometer'/exp OR 'handheld dynamometer' OR 'dynamometer'/exp OR dynamometer OR 'inguinal region'/exp OR 'inguinal region' OR 'neuromuscular function'/exp OR 'neuromuscular function' OR 'rate of force development'/exp OR 'rate

of force development' OR 'muscle function'/exp OR 'muscle function' OR 'weakness'/exp OR weakness OR 'frailty'/exp OR frailty OR 'strength isometric' OR 'hip muscle volume' OR 'strength testing' OR 'strength imbalance' OR 'strength deficit' OR 'strength difference' OR 'hip adductor muscle'/exp OR 'hip adductor muscle' OR 'hip abductor muscle'/exp OR 'hip abductor muscle' OR 'hip flexor muscle'/exp OR 'hip flexor muscle' OR 'hip rotator muscle' OR 'muscle isometric contraction'/exp OR 'muscle isometric contraction' OR 'isokinetic dynamometer'/exp OR 'isokinetic dynamometer' OR 'isokinetic strength'/exp OR 'isokinetic strength')

Pedro (3 articles)
“Femoroacetabular impingement” AND “ muscle strength”

Pubmed (4416 articles)
((muscle) OR (muscle activity)) OR (muscle strength)) OR (muscle weakness)) OR (paresis)) OR (muscular paresis)) OR (muscular modification)) OR (muscle fatigue)) OR (muscle contraction)) OR (contraction)) OR (hip muscles)) OR (strength)) OR (isometric strength)) OR (muscle ratio)) OR (iliocapsularis muscle)) OR (hip muscle strength)) OR (hip strength)) OR (hip muscle weakness)) OR (muscle dynamometer)) OR (dynamometer)) OR (handheld dynamometer)) OR (groin)) OR (neuromuscular function)) OR (rate of force development)) OR (muscle function)) OR (weakness)) OR (frailty)) OR (muscle strength dynamometer)) OR (strength isometric)) OR (isometric contraction)) OR (isometric)) OR (hip muscle volume)) OR (dynamometer)) OR (measurement)) OR (maximal voluntary contraction)) OR (strength testing)) OR (strength imbalance)) OR (strength deficit)) OR (strength difference)) OR (ratio)) OR (strength measurement)) OR (agonist)) OR (antagonist)) OR (hip adductor strength)) OR (hip abductor strength)) OR (hip flexor strength)) OR (hip rotator strength)) OR (isometric contraction)) OR (muscle strength dynamometer)) OR (isokinetic)) AND ((((((((((((femoroacetabular impingement) OR (hip impingement)) OR (femoroacetabular syndrome)) OR (femoroacetabular impingement syndrome)) OR (fai)) OR (fais)) OR (femoro-acetabular impingement)) OR (femoro-acetabular syndrome)) OR (femoro-acetabular impingement syndrome)) OR (cam impingement)) OR (pincer impingement)) OR (hip microinstability)) OR (symptomatic FAI))

Annexe II: Downs & Black Checklist modifiée

Beck and al. (2020)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.	X			
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
	Were those subjects who were prepared to participate representative of the entire population from which they were recruited?				X

12.	The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.				X
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.	X			

Bizzini and al. (2023)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.			X	
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?		X		
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited?				X

	The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.			X	
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.			X	

Brunner and al. (2015)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.			X	
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.	X			
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited?	X			

	The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.			X	
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.			X	

Casartelli and al. (2011)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.			X	
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited?				X

	The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.			X	
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.			X	

X

Catelli and al. (2018)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.			X	
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited?				X

	The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.	X			
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.			X	

Catelli and al. (2019)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.				X
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.				X
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited?				X

	The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.				X
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.			X	

Davis and al. (2016)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.	X			
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited?				X

	The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.		X		
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.			X	
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.			X	
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.				X

Diamond and al. (2015)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.			X	
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited?				X

	The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.			X	
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.			X	

Ebert and al. (2023)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.	X			
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.	X			
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited?				X

	The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.			X	
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.	X			

Frasson and al. (2018)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.			X	
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited?				X

	The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.	X			
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.			X	

Gonçalves and al. (2022)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.	X			
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited? The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the				X

	distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.		X		
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.	X			
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.	X			

Guenther and al. (2022)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.		X		
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.			X	
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited? The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the				X

	distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.		X		
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.		X		
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.			X	

Kierkegaard and al. (2020)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.			X	
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited? The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the				X

	distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.			X	
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.			X	

Kivlan and al. (2016)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.			X	
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited? The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the				X

	distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.				X
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.			X	

Konnaris and al. (2022)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.		X		
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.		X		
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?		X		
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.	X			
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited? The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the				X

	distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.			X	
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.	X			

Maffiuletti and al. (2020)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided		X		
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.			X	
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited? The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the				X

	distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.			X	
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.			X	

Malloy and al. (2015)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.			X	
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited? The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the				X

	distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.				X
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.			X	

Seijas-Vàzquez and al. (2020)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.			X	
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited? The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the				X

	distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.			X	
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.			X	

Servant and al. (2022)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.		X		
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited? The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the				X

	distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.			X	
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.				X

Wierks and al. (2021)

	Reporting	Yes (1)	No (0)	N/A (/)	Unable to determine (0)
1.	Is the hypothesis/aim/objective of the study clearly described?	X			
2.	Are the main outcomes to be measured clearly described in the introduction or methods section? If the main outcomes are first mentioned in the results section, the question should be answered as no.	X			
3.	Are the characteristics of the subjects included in the study clearly described? In cohort studies and trials, inclusions and/or exclusion criteria should be given. In case-control studies, a case-definition and source for controls should be given.	X			
5.	Are the distributions of principal confounders in each group of subjects to be compared clearly described? A list of principal confounders is provided	X			
6.	Are the main findings of the study clearly described? Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions.	X			
7.	Does the study provide estimates of the random variability in the data for the main outcomes? In non-normally distributed data, the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If distribution data is not described, it must be assumed that the estimates used were appropriate and the question should be answered with yes.	X			
8.	Have all important adverse events that may be a consequence of the intervention been reported? This should be answered yes if the study demonstrates that was a comprehensive attempt to measure adverse events.				X
9.	Have the characteristics of subjects lost to follow-up been described? This should be answered yes were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no, where a study does not report the number of patients lost to follow-up.	X			
10.	Have actual probability values been reported (e.g 0.035 rather than <0,05) for the main outcomes except where the probability value is less than 0,001?	X			
	External Validity				
11.	Were the subjects asked to participate in the study representative of the entire population from which they were recruited? The study must identify the source population for subjects and describe how the subjects were selected. Subjects would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the subjects are derived, the question should be answered as unable to determine.				X
12.	Were those subjects who were prepared to participate representative of the entire population from which they were recruited? The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the				X

	distribution of the main confounding factors was the same in the study sample and the source population.				
	Internal Validity				
16.	If any of the results of the study were based on "data dredging", was this made clear?				X
18.	Were the statistical tests used to assess the main outcomes appropriate? The statistical techniques used must be appropriate to the data. For example, nonparametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.	X			
20.	Were the main outcome measures used accurate (valid and reliable)? For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.	X			
	Internal Validity – confounding (selection bias)				
21.	Were the subjects in different intervention groups or were they recruited from the same population? For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case control studies where there is no information concerning the source of patients included in the study.	X			
25.	Was there adequate adjustment for confounding in the analyses from which the main findings were drawn? This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.				X
26.	Were losses of subjects to follow-up taken into account? If the numbers of subjects lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.	X			