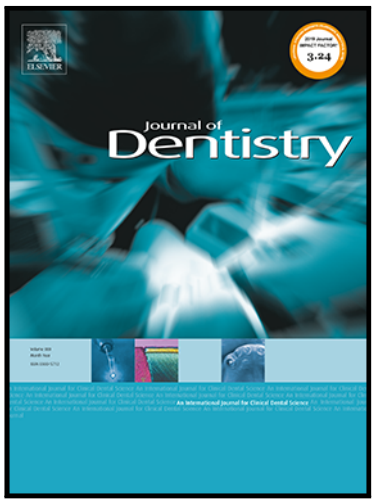

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Hypnosis on acute dental and maxillofacial pain relief: A systematic review and meta-analysis

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Abstract

Introduction/objectives: The effects of hypnosis on acute pain have been discussed recently, resulting in increased attention in the dental/maxillofacial field offering new perspectives, especially in emergency situations, trauma, or acute inflammatory situations where conventional pharmaceuticals are contraindicated due to allergies or intolerance reactions.

Data: To systematically evaluate and assess the effects of hypnosis on acute dental/facial pain relief. Randomized controlled trials, cohort studies, controlled clinical trials, cross-sectional studies, evaluation, and validation studies, following the PRISMA guidelines, of human subjects of all ages were included.

Sources: Five electronic databases (Cochrane, Embase, MEDLINE via PubMed, LILACS, Scopus) were screened for studies published between 1989 – 2021. A NIH quality-assessment-tool was performed.

Study selection/results: 27 papers have been included and a meta-analysis was performed**.** Hypnosis has been reported to reduce intraoperative and postoperative pain as well as the use of analgesics in various dental procedures such as tooth extraction. Highly hypnotizable subjects generally respond better to hypnosis. Different hypnosis techniques were used for pain relief and relaxation. The studies show a large heterogeneity.

Conclusion: Although there are only a small number of studies on the subject so far, evidence can be confirmed for the effects of hypnosis on acute pain relief in dental/maxillofacial area. Despite the promising results, further research is needed.

Clinical significance: Hypnosis offers a possible alternative to conventional pain medications for acute dental and maxillofacial pain, especially in cases of allergies or contraindications; it can be easily applied by a trained practitioner.

Keywords: acute; pain; dental; hypnosis; systematic review

Hypnosis on acute dental and maxillofacial pain relief:

A systematic review and meta-analysis

Introduction

Safe, effective and painless treatment is aimed for a clinically practicing dentist [1]. Therefore, acute pain relief in dental/maxillofacial area is essential. Local anaesthetics are routinely used for acute pain management, such as in emergency situations like injury, trauma, or even acute inflammatory reactions, as well as analgesics for postoperative analgesia are prescribed by prescription [2]. However, there are numerous contraindications to local anaesthetics, such as allergies or intolerance reactions to preservatives, which make anaesthesia impossible. Alternatives to analgesia are therefore necessary in order to be able to treat such patients without or with little pain [1]. Hypnosis offers a possible alternative to conventional pain medications that can be used relatively easily by a trained practitioner [3]. According to the American Psychological Association (APA) Division 30, hypnosis is defined as "a state of consciousness associated with focused attention and reduced peripheral awareness and characterized by an increased ability to respond to suggestion" [4]. However, the term "hypnosis" is often used as a collective term for various hypnosis methods, such as hypnotherapy, self-hypnosis, as well as other hypnosis. It could also be described as a state of focused attention, concentration, and internal absorption with a conditional inhibition of peripheral perception. Furthermore, it can be made up of three main components; absorption (tendency to fully engage in a perceiving, imaginative or ideal experience), dissociation (mental separation of behavioural components that would normally be processed together) and suggestibility (increased tendency to follow hypnotic instructions) [5]. Former reports showed positive effects of hypnosis treatment on pain and even a significant reduction in intra- and postoperative pain as well as a lower consumption of painkillers [6–8]. A systematic review of hypnosis for general pain relief found moderate to strong analgesia for all pain parameters in addition to other key findings [9]. Hypnosis can therefore not only be used as the sole therapy, but also adjuvant to local anaesthesia and to support non-hypnotic techniques and improve their effects [10]. In the field of acute dental pain and its reduction or elimination by dental hypnosis, a lot has been done in recent years, and several clinical studies have been published. That interest in hypnosis in the context of acute dental pain has increased is well indicated by the fact that more than half (15 of 27) of the studies assessed were published in the last 10 years (2011-2021). A systematic review of the existing evidence and a meta-analysis should therefore be performed, the studies be evaluated and assessed as well as limitations critically be discussed.

Material and Methods

Reporting of this systematic review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [11]. The review protocol was registered with the international prospective register of systematic reviews (PROSPERO) system on 5 July 2020 (ID- CRD42020187935).

Eligibility criteria

The review included randomized controlled trials, cohort studies, controlled clinical trials, cross-sectional studies, evaluation, and validation studies reporting hypnosis and its effect on (clinical/experimental) acute pain management during dental procedures in human subjects of all ages. Only papers in English published from the 1st of January 1989 to the 31st of December 2021 were collected and included.

Information sources

Five electronic databases (Cochrane, Embase, MEDLINE via PubMed, LILACS, and Scopus) were screened for articles. Only studies on human subjects of all ages were included. Grey literature was also retrieved (www.opengrey.eu).

Information sources and search strategy

To achieve the desired results, the PICO help scheme was applied:

- P (Population): Subjects who have experienced acute pain during clinical/experimental dental setting
- I (Intervention): Any kind of hypnosis / hypnotic intervention as replacement or adjuvant therapy
- C (Comparison/Control): None / Alternative therapies for pain relief (e.g. local anaesthesia, relaxation exercises without hypnosis)
- O (Outcome): Change in pain perception or reduction / elimination of acute pain

The search strategy used included three different strings, each of them was a combination of MeSH terms and key words: 1) *Hypnosis* OR *hypnotherapy* OR *hypnotic* OR *hypno** OR *self-hypnosis*, 2) *pain* OR *pain-relief* OR *acute pain* OR *distress* OR *hurt* OR *ache* OR *pain threshold* OR *experimental pain* OR *clinical pain* OR *procedural pain* OR *pain perception* and 3) *dental* OR *tooth* OR *teeth* OR *dentistry* OR *molar** OR *canin** OR *incisor** OR *dentist*. Cross-referencing was performed using the bibliographies of full-text articles (Suppl. Table 5).

Study selection

The PRISMA Flow Diagram was used to systematically classify and select the papers collected from the five different databases (Figure 1) [11]. Repeated or duplicate papers were excluded after comparing the results from the five databases. Two authors independently examined all abstracts of the papers (A.M., T.G.W.). All papers meeting the inclusion criteria were obtained in the full-text format. The authors independently assessed the papers to establish whether each paper should or should not be included in the systematic review. At the end of this process, 27 studies remained that met the inclusion criteria and were thus included in the review (Table 1).

Data collection and synthesis

Data was extracted and synthesized using an *ad hoc* designed data extraction form, without masking journal title and authors. Data from different study outcomes were compared on the use of hypnosis to reduce or even prevent from acute experimental or clinical pain during dental treatments. Experimental dental pain is performed in reproducible, standardized conditions unrelated to dental treatment in controlled environments to test specific hypotheses. To facilitate the data synthesis, the results were summarised in tables where each selected paper was included and the main aspects presented (*i.e.,* hypnotic intervention studies; sample and age; chronic muscle, jaw or facial pain at baseline, effect on acute pain, statistically significance). For each paper, the following data was searched and recorded when available: a) Type of study, location, publication year and study duration; b) Number/age range/sex of the participants at baseline; c) Type of hypnosis and control intervention; d) Study design and groups treatment; e) Method of pain management; f) Hypnotisability, if tested or not and how; and g) Physical and pathological condition and h) Outcomes relating to pain (Table 2).

Meta-analysis

Meta-analysis of the data was carried out using the ProMeta 3 Software (IdoStatistics https://idostatistics.com/prometa3/, Cesena, Italy: Internovi). Mean difference (MD) and odds ratio (OR) were chosen for calculating the effect size. The analyses were calculated separately by dividing the parameters examined by the studies into the following subgroups for comparison: a) Hypnosis for tooth extraction, b) Hypnotisability, c) Method of pain measurement and d) Hypnosis technique used. The I^2 statistic was calculated to describe the percentage of variation across studies due to heterogeneity rather than chance [14]. The heterogeneity was categorized as follows: <30% not significant; 30–50% moderate; 51–75% substantial, and 76–100% considerable. Whether homogeneity was obtained or not, the random effects model (REM) with 95% confidence intervals was chosen as the meta-analysis model. Potential moderators as publication type, publication year, age groups, pre-

experimental chronic pain, hypnotisability were evaluated and analysed to explain which factors might affect heterogeneity. The funnel plot method was used to assess the potential role of publication bias [15]. The significance levels of the effect sizes were determined based on the two-tailed test. In all tests, the level of significance was set at $p < 0.05$.

Assessment of bias across studies

The risk of bias assessment was performed by two authors (A.M., G.C.). The methodological quality of the included RCTs was scored according to the customized quality assessment tool developed by the National Heart, Lung, and Blood Institute and Research Triangle Institute International for Observational Cohort and Cross-Sectional Studies and Study Quality Assessment Tools Guidance for Assessing the Quality of Controlled Intervention Studies [https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools]. The tools were used to identify potential errors in study methods or implementation, including sources of bias (e.g., patient selection, performance, recognition, order of experiments), confounding, study power, the strength of causality in the association between interventions and outcomes, and other factors. For each item, a "yes", "no" or "cannot be determined/not reported/not applicable" was selected depending on the assessment option. Then, based on the sum of "yes" scores, each study was rated either "good" if there is a low risk of bias, "fair" if there is some susceptibility to bias, and "poor" if there is a significant risk of bias. Insecurities concerning the methodological quality of the included studies were resolved by consulting a third author (T.G.W.). The possibility whether the analysis of studies stratified by (i) Risk of bias or (ii) Study design yielded similar or different results was also taking into consideration. For this (i) Studies at high risk of bias or (ii) Studies using a cross-sectional design were dropped in a second/third analysis.

Results

Search results

The search strategy made it possible to identify 392 studies in the five databases consulted, of which 295 studies remained after removing the duplicates. 261 studies were excluded after reading the title, leaving 34 studies, of which 7 were excluded after reading the abstract/full text. The remaining 27 studies were then all evaluated in terms of their quality using the quality assessment tool mentioned above (Figure 1).

After evaluation using the quality assessment tool, 14 of the 27 papers were rated as being of "good" quality and the remaining 13 of "fair" quality. None of the papers was rated as of "poor" quality (Table 1).

Hypnosis for tooth extraction (Suppl. Table 1)

Five studies on tooth extraction under hypnosis have been published, five [12–16] of which chose hypnosis as a support for local anaesthesia and only two [17,18] used hypnosis exclusively to eliminate pain. Under the sole use of hypnosis for wisdom tooth extraction, the patients had significantly less pain intra- and postoperatively, and the intake of painkillers was significantly lower compared to the control group [17]. In the second study, in which the data were not normally distributed, hypnosis also generated a reduction in pain, but not significantly [16].

When hypnosis was combined with local anaesthetics, three [14,15,18] out of five studies found a significant decrease in pain with additional hypnosis. Regarding the consumption of painkillers, a significant reduction was found in four [12,14,15,18] of five studies. The meta-analysis (Random-effects REML model) performed on tooth extraction is shown in Figure 2.

Hypnotisability (Suppl. Table 2)

The hypnotisability of the study participants was tested in 11 [19–29] of the 27 studies [12–38], of which it was considered a relevant inclusion criterion in four studies [25–28]. The subjects were divided into low and high hypnotisability groups and compared against each other, whereby hypnosis usually showed better results in the highly hypnotizable groups. The meta-analysis (Fixed-effects inverse-variance model) performed on hypnotisability is shown in Figure 3.

Method of pain measurement (Suppl. Table 3)

A total of ten different methods were used to record the pain, some of them in combination with each other. Both the visual analogue scale (VAS) and the numerical rating scale (NRS) are used for the subjective assessment of the patient's pain, the former being used in 19 studies [12–15,17,19,23,25–30,32,33,35–38] and the latter in four studies [20–23]. The

McGill Pain Questionnaire provides quantitative measures of clinical pain and has been used in two studies [19,22]. The number of painkillers taken postoperatively can be used to determine the perceived pain, which is why this measurement method was also used in eight [12–17,19,22] studies. Furthermore, the perceived pain was determined by the pain threshold [23,31], FLACC (face, leg, activity, cry, consolability) [34], the modified Objective Pain Score (mOPS) [33], fMRI (functional magnetic resonance imaging) [21], Wong-Baker Faces Pain Rating Scale (WBS) [16] or a blind observer [24].

Technique for hypnosis (Suppl. Table 4)

The most common hypnotic technique used in the studies was the standardized hypnotic induction (suggestion [19], Chiasson's Technique / fixing the gaze [17] etc.), either once at the time [14–18,24–27,29–31,33,34,37,38] of the experiment or several times pre-experimentally [12,13,19–23,36]. Regardless of the number of hypnosis sessions, therapeutic successes could be shown and no clear superiority of either of the two is evident. Other hypnosis induction techniques applied were glove anaesthesia [21,27,39], hypnotic focused analgesia [23,25,26,31], cognitive behavioural therapy [32,35], brainwave music [32] or clenching on a wooden stick [28]. Regarding focused hypnotic analgesia, a superiority over relaxation and sometimes even hypnosis can be seen [23,25,31]. When excluding studies at high risk of bias (or studies with different study designs), no meta-analysis was possible. Thus, no sensitivity analysis could be performed; moreover, due to the high heterogeneity of the included studies (included population, outcomes, high risk of bias, etc.), no meta-analysis was performed.

Discussion

The aim of the present study was to systematically review studies about effects of hypnosis on acute pain relief in dental/maxillofacial area. Possibilities and limitations of hypnotic interventions should be demonstrated and be an impulse for the scientific community to continue to pursue this exciting field. Already several studies [6–10] could prove the mainly supporting and supplementing effects of hypnosis by clinical trials. Of course, the limitations of hypnotic pain therapy have also been shown several times [12,13,37], whereby not infrequently the attitude and abilities of the subject towards the alternative therapy were the cause of the lack of success [25–28,39,40].

There are some important systematic reviews and meta-analyses that support the positive effects of hypnosis in pain, irritable bowel syndrome and post-traumatic stress disorder, among others [7,9,41–43]. Nevertheless, hypnosis, in terms of hypnotic pain reduction, is more difficult to assess than other forms of suggested sensory change. In both clinical and experimental settings, the nature of responding to painful stimulation varies depending on the individual "meaning" of the pain to the patient, cultural factors, personality variables or the presence of certain forms of psychopathology [39,40]. In the section dealing with dental extractions, hypnosis was generally used to support and supplement the use of local anaesthetics, whereby the study population was generally divided into two groups, one of which was "hypnotized" in addition to anaesthesia. In one study [17], subjects were their own control, and a tooth was extracted purely under hypnosis, without any sedation of the area in question. Another study [18] also extracted teeth exclusively under hypnosis, but the pain measurement method was not reported, making comparison within these two studies difficult. Four [14–17] of the seven studies were able to demonstrate significantly pain reduction by hypnosis during the application of anaesthetics. In two former mentioned studies[17,18], hypnosis was equated with anaesthesia and showed better outcomes for both, but only significantly for the former [17]. The reason for this is probably the distraction from the event caused by hypnosis, which causes the patient to focus away from the possible perception of pain. About postoperative analgesics intake, five [12,14–17] of the seven studies [12–15,17,19,22] showed a significant reduction.

Hypnotic suggestibility is intended to describe the characteristics and mechanisms of the hypnotic response and thus to reveal the hypnotisability of an individual and the ability to respond to hypnotic suggestions, to reveal and, if necessary, to divide into different groups (low, medium, high) [40].

There is disagreement as to when and how the measured data should be integrated into experimental studies, as the knowledge of hypnosis has evolved in areas of clinical and cognitive neuroscience. In the clinic hypnotisability has only a low predictive value, whereas in experimental studies a stronger and more constant prediction about the responsiveness to

suggestion can be made [19–29,40]. This explains why, some studies [25–28] saw a need for the determination and subsequent classification of hypnotisability.

As already mentioned, a total of ten different methods [12–38] were used to measure pain. Both the visual analogue scale (VAS) and the numerical rating scale (NRS) are used to obtain a subjective assessment of the patient on paper. The two scales are very similar in their practical application, but unlike the VAS, the NRS can also be used in oral health. In addition, the data of the same patient on both scales differ slightly and can therefore not be compared one-to-one [44]. The relatively small difference between VAS and NRS is offset by the larger differences between the other pain measurement methods, which influences the comparison of the studies. On one hand, subjective measurement methods influenced by the patient were used, and on the other hand the practitioner assessed the objectively visible pain. The dependence on the cooperation of the patient also weakens the significance of the results.

Another subgroup deals with chronic temporomandibular joint, masticatory muscle and facial pain and the possible benefits of hypnosis in this respect. The types of pain described in the six studies [19–23,36] are generally similar, but show different symptoms, making it difficult to compare hypnosis therapy [22,23,45]. Since the focus of this review was exclusively on acute pain control, this subgroup will not be discussed further.

Many different methods have been used to induce hypnosis [12–38]. However, two large groups can be distinguished, one is self-hypnosis [37,38] and the other is external hypnosis [12–38], whereby the latter can be done by a person or a medium (CD/DVD etc.). The most common was the standardized hypnotic induction [12–27,29–31,33,34,36–38], based on suggestions [12–16,18–27,29–31,33,34,36], "Chiasson's Technique" [17] or "fixing the gaze" [16,17], either only once or several times until the start of the experiment [17,19].

Despite the great heterogeneity of hypnosis techniques, no superior method could be found, nor was there any difference in the number of hypnosis sessions and therapeutic success [14–27,29–31,33,34,37,38]. This makes it therefore impossible to recommend a specific induction method. Only hypnotic focused analgesia [23,25,26,31] was found to be superior to relaxation and sometimes even hypnosis, which is why this type of hypnosis should be emphasized [23,25,31].

A limiting aspect of this work lies in the great heterogeneity of the studies. As already shown, the effect of hypnosis is researched in a broad field of clinical and experimental studies, but this makes it all an even more difficult task to compare the data. Regarding the topic of acute pain and its elimination, it must be noted that it varies greatly not only between individuals, but also because of the treatment administered. A further limitation is the limited data from only 27 studies. Although the results of most of the studies are promising, the small number of participants means that they are not very meaningful. It would therefore be beneficial and

necessary for more research to be carried out in this area to make clearer statements. To do this, uniform measuring methods and larger numbers of test persons should be used wherever possible.

Conclusions

- Hypnosis supporting tooth extractions can reduce intra- and post-operative pain as well as the consumption of analgesics
- Highly hypnotizable subjects respond better to hypnosis than low hypnotizable subjects
- Various hypnosis-techniques were used in studies
- Great heterogeneity of the studies, interindividual differences in pain perception and small number of studies and subjects
- Further research using standardized methods and larger study populations are needed

Informed Consent

All participants were adults and an informed consent for the processing of their data was obtained by accessing the online survey.

Declaration of Competing Interests

The authors declare they have no conflict of interest.

Patient and Public Involvement

Not applicable.

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N/A

Summary: This systematic review with meta-analysis shows heterogeneity of studies included. However, evidence can be confirmed for hypnosis effects on acute pain relief in dental/maxillofacial area.

Credit author Statement

Anuschka E. Merz: Conceptualization, Methodology, Software, Data Curation, Writing – Original Draft preparation

Guglielmo Campus: Conceptualization, Methodology, Software, Data Curation, Visualization, Supervision, Wiritng – Review and Editing

Randi Abrahamsen: Data Curation, Visualization, Validation, Data analysis, Writing – Review and Editing

Thomas G. Wolf: Conceptualization, Methodology, Software, Data Curation, Visualization, Supervision, Writing – Review and Editing, Project administration

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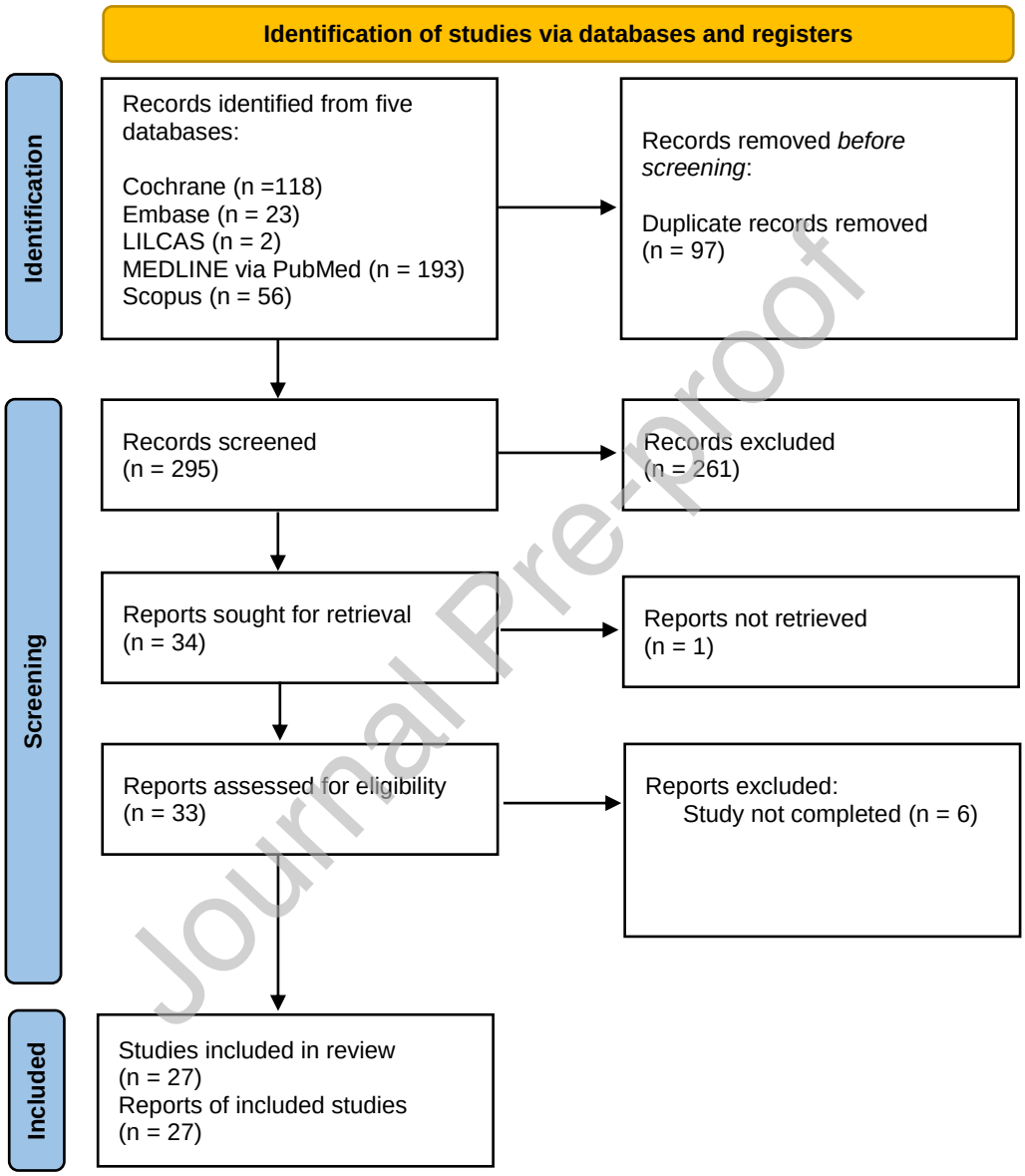
Legend

Table 1: General characteristics of the studies included and quality assessment.

Table 2: Extracted data out of the 27 included studies in chronological order.

Figure 1: PRISMA Flow Diagram



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).

**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

Figure 2: Meta-analysis: Tooth extraction

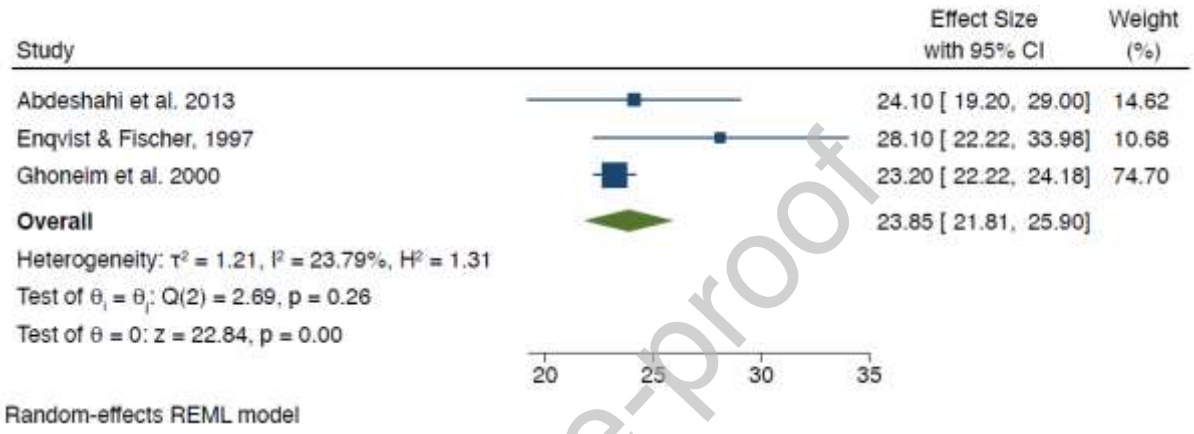
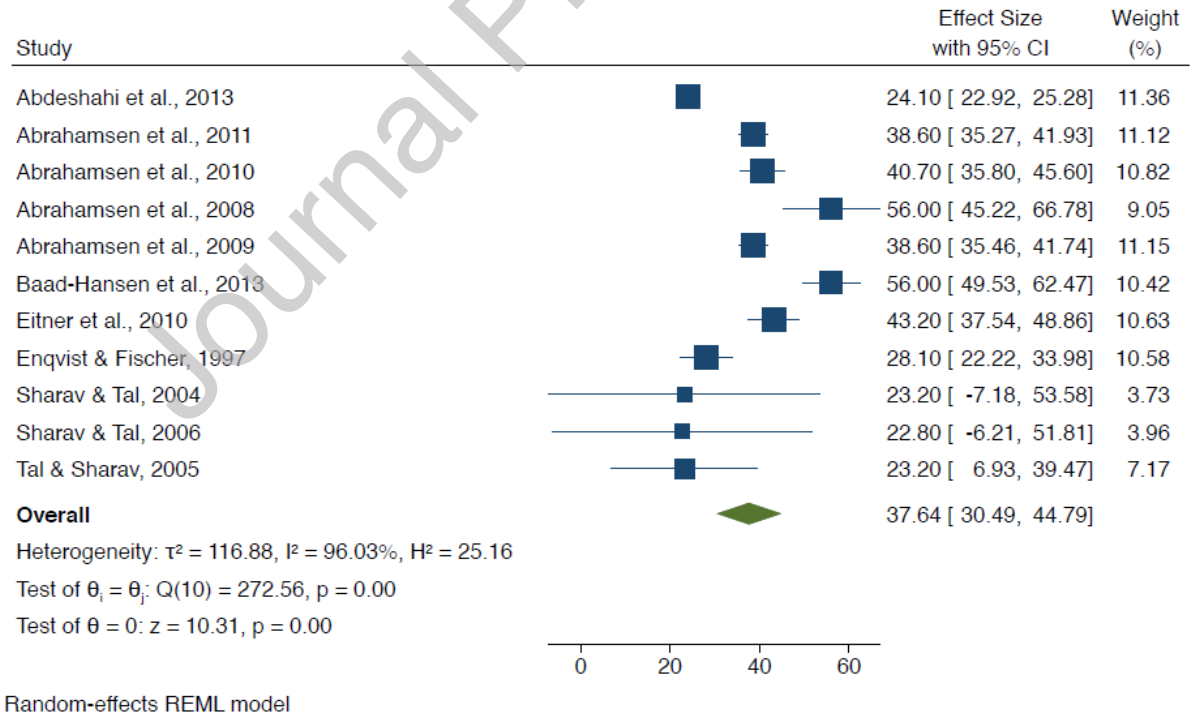


Figure 3: Meta-analysis: Hypnotisability



Suppl. Table 1: Hypnosis for tooth extraction

Suppl. Table 2: Hypnotisability

Suppl. Table 3: Method of pain measurement

Suppl. Table 4: Technique for hypnosis

Suppl. Table 5: String literature search

Table 1: General characteristics of the studies included and quality assessment.

ID	Author(s)	Year	Source	Study typ	Quality Assessment
1	Abdeshahi et al.	2013	J Craniomaxillofac Surg 2013;41(4):310-315	CCS	Fair 8
2	Abrahamsen et al.	2011	Clin J Pain 2011;27(4):344-351	RCT	Fair 9
3	Abrahamsen et al.	2008	Pain 2008;136(1-2):44-52	RCT	Fair 10
4	Abrahamsen et al.	2010	Pain 2010;151(3):825-833	RCT	Fair 8
5	Abrahamsen et al.	2009	J Oral Rehabil 2009;36(8):556-570	RCT	Good 11
6	Adibahanum et al.	2020	PJMHS 2020;14(2):1502-1505	CT	Fair 7
7	Baad-Hansen et al.	2013	Clin J Pain 2013;29(6):518-526	RCT	Good 11
8	Eitner et al.	2010	Int J Clin Exp Hypn 2010;58(4):457-475	RCT	Fair 8
9	Enqvist et al.	1997	Int J Clin Exp Hypn 1997;45(2):102-108	CT	Good 13
10	Facco et al.	2011	Int J Clin Exp Hypn 2011;59(4):454-468	CT	Fair 7
11	Ghoneim et al.	2000	Anesth Analg 2000;90(1):64-68	CT	Fair 10
12	Huang et al.	2016	Oral Dis 2016;22(8):766-774	RCT	Good 13
13	Huet et al.	2011	Int J Clin Exp Hypn 2011;59(4):424-440	RCT	Good 11
14	Mackey	2010	Int J Clin Exp Hypn 2010;58(1):21-38	RCT	Good 12
15	Mackey	2018	Am J Clin Hypn 2018;60(4):378-385	RCT	Good 12
16	Moghadam et al.	2021	Clin Exp Dent Res 2021;7(3):399-405	CT	Good 11
17	Ramirez-Carrasco et al.	2017	Pain Res Manag 2017;1:1-5	RCT	Good 11
18	Oberoi et al.	2016	Pediatr Dent 2016;38(2):112-115	RCT	Good 12
19	Sabherwal et al.	2021	Eur Arch Paediatr Dent 2021;3(29);1-10	RCT	Good 14
20	Sharav et al.	1989	Brain Res 1989;479(2):247-254	CT	Fair

					8
21	Sharav et al.	2004	Int J Psychophysiol 2004;52(2):187-96	CT	Fair 10
22	Sharav et al.	2006	Pain 2006;124(3):280-286	CT	Fair 10
23	Tal et al.	2005	J Orofac Pain 2005;19(1):76-81	RCT	Fair 10
24	Wang et al.	2015	Oral Dis 2015;21(5):572-582	RCT	Good 13
25	Winocur et al.	2002	Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2002;93(4):429-434	CS	Fair 9
26	Wolf et al.	2016	Int J Clin Exp Hypn 2016;64(2):187-199	RCT	Good 12
27	Wolf et al.	2016	Int J Clin Exp Hypn 2016; 64(4):391-403	RCT	Good 12

CCS: Case-control study; CS: Comparative Study; CT: Clinical Trial, RCT: Randomized Clinical Trial. CCS: Case-control study; CS: Comparative Study; CT: Clinical Trial, RCT: Randomized Clinical Trial.

Table 2: Extracted data out of the 27 included studies in chronological order.

Author, Year	Subjects, Age-range	M/F	Study length	Hypnosis	Groups Treatment	Pain measurement	Hypnotisability	P/PC	Outcomes relating to pain
Enqvist et al., 1997	69 H: 27.7±6.23 C: 28.5±5.35	M/F	5 weeks	SHI + AT	2 groups H C	VAS AI	Not tested	No previous experience with third molar removal	AI: H 32 C: 26 p<0:01
Sharav et al., 1989	17 (18-38 yy)	M/F	3 days	H GA	Two experiments: H non-painful/painful stimulus levels	VAS	Tested SHALIT GA	Selection based on the ability to be hypnotized	Non-painful stimuli: pre-H:94.3% H:14.1% p<0.01 Painful stimuli: pre-H:100% H: 28% p<0.01 Sensory threshold: pre-H: 30.0 µA H:33.1 µA p= 0.10 Pain threshold: pre-H: 50.3 µA H: 60.3 µA p= 0.10 Perceived intensity electrical tooth-pulp stimulation Placebo: p= 0.02 H: p< 0.01 HA p<0.01 Supra-pain stimuli: saline: 50% painful H: 18% painful p<0.05
Ghoneim et al., 2000	60 (18-35 yy)	M/F	1.5 weeks	SHI + AT LA+H	2 groups H C	VAS AI	Not tested	Surgical removal of their molar teeth (4, 3 or 2 teeth per patient)	Pain: H:15.8±23.0 C:16.3± 25.4) p>0.05 AI: Vicodin p=0.90 Ibuprofen p=0.87
Wincour et al., 2002	40 (16-49 yy)	F	49 days	PMR H R+AT	3 groups HR OA MT	VAS	Not tested	MPD (myofascial pain disorder)	HR: H vs C p<0.01 occlusal appliance v. C p=0.05 Muscle sensitivity: H vs. C p< 0.01 occlusal appliance vs C p<0.05 Pain: H p<0.01
Sharav et al., 2004	15 (21-26 yy)	M/F	2 weeks	R FA	2 groups HH LH	VAS	Tested SHALIT	Hypnotic susceptibility	PI p<0.01 FA: p< 0.05 R: p=0.07 HH: p= 0.02 R: p=0.10 LH: FA: p=0.10 R: p=0.50 PI FA: HH-subjects: 15.8±2.87 LH-subjects: 0.3±1.43 p<0.01 PI: HH-subjects: 9.2±2.0 LH-subjects: 5.1±1.41 p=0.50 PI in HH: FA p<0.05 R: p=0.02 PI in LH: p=0.05 R: p<0.05
Tal et al., 2005	16 (21-26 yy)	M/F	1 day	Wooden bite stick between the molars	2 groups HH LH	VAS	Tested SHALIT	Hypnotic susceptibility	VAS: HH: p=0.01 LH: p= 0.21 Nonpainful stimuli HH: reduction in VAS p=0.02
Sharav et al., 2006	25 (18-32 yy)	M/F	2 weeks	SHI FA	2 groups HH LH	VAS	Tested SHALIT	Hypnotic susceptibility	HH and LH p=0.13 p=0.44 PI: HH: p<0.01 LH p< 0.01
Abrahamsen et al., 2008	41 (56 ± 1.9 yy)	M/F	-	5 sessions SHI + AT	2 groups H	VAS McG	Tested D-test	PIOP (persistent idiopathic orofacial	VAS: H=33.1±7.4% C=3.2±5.4%

					C	DpPA AI		pain)	P= 0.03 McG: H=34.9±11.6 C=20.2±10.0 *p*< 0.01 AI: H=-6.6±2.9 C=-0.8±1.3 p<0.02
Abrahamsen et al., 2009	40 (38.6 ± 10.8 yy)	F	-	4 1h sessions SHI + AT	2 groups H C	NRS McG AI	Tested D-Test	Myofascial TMD pain	PI: H t0 = 4.5±4.6 t3 =2.9 ±2.4 P<0.01 C t0 = 4.2± .4 t3 =3.9±1.5 P= 0.73 McG= p=0.10 AI: H t0=15.6±19.9 t3 7.1±8.9 C t0=14.7±18.9 t3 14.1±17.5 r
Abrahamsen et al., 2010	19 (40.7±2.3 yy)	M/F	-	1h session SHI + GA	1 group, 3 different conditions: C Hx hypH	NRS fMRI	Tested D-test	Myofascial TMD pain	NRS Pain Score: H=2.9±0.4 p< 0.01 52.2 ±23.6% reduction H=7.3±0.4 p<0.01 47.4±32.6% increase NRS unpleasantness: H=2.8±0.3 p<0.01 30.8±35.2% reduction Hx=6.7± 0.4 p<0.01 54.2±40.1% increase
Eitner et al., 2010	102 (41.3 yy)	M/F	1 month	SHI	4 groups Des F H C	VAS	Not tested	Dentin hypersensitivity (DHS)	F: 2.27 increase Des: 2.86 increase H: 2.89 increase C: 1.6 points increase p= 0.02
Mackey 2010	91 (18-25 yy)	M/F	2 days	IVS +AT	2 groups H C	VAS AI	Not tested	No hypnotic experiences surgical removal of impacted third molars	Postoperative Pain: H: 2.57±1.48 C: 3.97±1.45 p< 0.01 AI post-op: H: 2.95±1.96 C: 4.22±1.50 p<0.01
Abrahamsen et al., 2011	39 (38.6±10.9 yy)	F	2 weeks	4 1h sessions SHI + AT	2 groups H C	NRS	Tested D-test	Persistent myofascial pain	H Bas=4.6±2.2/F-up=2.9±2.5 p<0.01 47.7% reduction C=no differences p=0.73 3.8% reduction
Baad-Hansen et al., 2013	41 (56 ± 1.9 yy)	M/F	-	3-6 1h session HFA + AT	2 groups H C	VAS NRS PT	Tested D-test	PIOP (persistent idiopathic orofacial pain)	H p= 0.06 active H p<0.01
Wang et al., 2015	24 (18-28)	M/F	1 month	2 sessions CBT	2 groups: CBT C	VAS	Not tested	-	PI: VAS p=0.04
Oberoi et al., 2016	200 (6-16 yy)	M/F	1 day	SHI prior LA	2 groups: H C	Blinded Observator	Tested: SHALIT	Pulp therapies in primary/permanent molars	Physical/verbal resistance: H: 68.1% C: 31.9% p<0.05
Wolf et al., 2016 (1)	37 (21-54 yy)	M/F	1 day	H	1 group, 2 conditions: Self-H C => PT and PP	VAS	Not tested	Anterior tooth tested: healthy and vital tooth without previous dental treatment	PT H= 57.1 ± 17.1 C= 39.5 ± 11.8 p< 0.01 PT H=4.0 ± 3.8 C=7.1 ± 2.7 p<0.01
Wolf et al., 2016 (2)	34 (21-54 yy)	M/F	2 days	H	1 group, 2 conditions: Self-H LA	VAS	Not tested	healthy lateral incisor or canine	PT H=58.3 ± 17.3 LA=79.4 ± 3.6 p< 0.01 PI H= 3.9±3.8 LA=0.0±1.7 p<0.01
Ramirez-	40	M/F	1 day	SHI	2 groups	FLACC	Not tested	Dental treatment	FLACC:

Carrasaco et al., 2017	(5-9 yy)				H C			had to include a local anesthetic	p>0.05
Mackey 2018	143 (18-25 yy)	M/F	2 days	IVS +AT	2 groups H C	VAS AI	Not tested	No hypnotic experiences; surgical removal of impacted third molars	Postoperative Pain: H: 1.48±2.57 C: 3.97±1.45 p<0.01 AI post-op: H: 1.96±2.95 C:4.22±1.50 p<0.01
Adibahanum et al., 2020	34 (17-23 yy)	M/F	1 month	H	2 groups H+LA LA	Not mentioned	Not Tested	Permanent tooth that is indicated for extraction	PI p=0.205
Moghadam et al., 2020	32 (18-25 yy)	M/F	-	LA LA + H	Single-blind clinical trial 2 groups LA LA + H	VAS	Tested by locking hand	Patients undergoing restorative dentistry of the anterior maxilla	Pain Control H: 1.81±1.39 Pain Control No H: 5.03±1.93 P= 0.04
Sabherwal et al., 2020	60 (8-12 yy)	M/F	1.5 years	H EA PMR	3 groups: H PMR C	WBS	Not tested	Children (8-12 yy); extraction of one primary molar as first dental intervention	WBS: H:1.30±1.63 PMR:1.80±2.42 P< 0.01 Pain: C:4.80±2.46 p<0.01 Analgesic requirement: H: 45% PMR:50% C:100%
Abdeshahi et al., 2013	24 (18-30yy)	M/F	-	SHI	2 groups: H LA	VAS AI	Not tested	Need of bilateral extraction of mandibular/maxillary third molars	Pain: H: 2(8.3%) LA: 8(33.3%) p 0.04 VAS postoperative pain 5h/12H: H: 2 (±2.1) / 1.6 (±1) LA: 4.5 (± 2.4) / 2.3 (±2.2) p < 0.01 / = 0.03 AI: H:10(41.7%) LA: 22(91.7%) p: <0.01
Facco et al., 2011	31 (28 ± 4.6 yy)	M/F	-	SHI HFA	1 group H+HFA RPM H LPM	PT	Not tested	A few had knowledge and/or experience of hypnosis	PT during: RPM with H+HFA: +220% p<0.01 LPM with H: +132% p<0.01 PT posthypnotic: RPM: +80% p<0.01 LPM: +50% p=0.05 PT during: RPM/LPM p=0.02
Huang et al., 2016	36 (22 ± 3yy)	M/F	1 month	BWM CBT	3 groups BWM CBT C	VAS	Not tested	Mild to moderate malocclusion and no previous orthodontic treatment	Pain: Time.dependetn decreasing in BWM/CBT/C p<0.01 Significantly lower VAS day 1-4 in BWM/CBT Significantly lower VAS in BWM day 2-4
Huet et al., 2011	30 (5-12yy)	M/F	3 months	H	2 groups H C	VAS mOPS	Not tested	Dental restorative treatments or pulpotomies of primary teeth (canines/molars) requiring dental anesthesia by buccal infiltration	Pain mOPS: H: 1.07±1.05 C: 2.86±2.16 p<0.05 Pain VAS: H: 4/14 C:2/15 p=0.01 VAS ≥ 3: H: 2/14 C: 9/15 p=0.01

H=hypnosis; C= Control; LA=Local Anesthesia; PPC=Physical/pathological condition; Hx= Hypnotic hyperalgesia; hypH= Hypnotic hypoalgesia; HR= hypnorelaxation; HH= High Hypnotizable, LH= Low Hypnotizable; FA= Focused Analgesia; HFA= Hypnotic Focused Analgesia; GA=Glove Anesthesia; EA= exhalations anesthesia; AT= Audio Tape; p= P-value; CCS= Case-Control-Study; RCT= Randomized-Clinical-Trial; PT= Pain Threshold; PI= Pain Intensity; PP= Pain Perception; D-test= Danish version of Harvard Group Scale of Hypnotic Susceptibility (HGSHS:A) Scale from 0-12; VAS= Visual Analogue Scale; NRS=Numeric Rating Scale; SHI= Standard Hypnotic Induction; SHALIT= Stanford Hypnotic Arm Levitation Induction and Test; McG=McGill pain questionnaire; R=Relaxation; DpPA=Drawing of perceived Pain Area; CBT= Cognitive Behavioral Training; mOPS= modified objective pain core; WBS= Wong-Baker Faces Pain Rating scale; BWM= Brainwave music; FLACC =Face, Legs, Activity, Cry, Consolability; AI=Analgesics intake; OHI= Oral Hygiene

Instructions; F= Fluoridation (Elmex Gel); Des=Desensitizer (Gluma); LPM= Left Premolar; RPM= Right Premolar; PMR= Progressive Muscle Relaxation; MT= Minimal Treatment; OA= Occlusal Appliance; IVS= Intravenous Sedation

Table 3

Table for publication bias:

ID	Type of study	Authors	Source	Sample size	Age		sex
					Mean	*Range*	
1	CCS	Abdeshahi et al.	J cranio-maxillo-facial surg 2013; 41(4): 310-15	24	24.1 ± 2.7 (M+F) / 23.6 ± 1.9 (M) / 24.7 ± 3.7 (F)	18-30 (M+F) / 21-27 (M) / 18-30 (F)	14 (M) / 10 (F)
2	RCT	Abrahamsen et al.	Clin J of Pain 2011; 27(4): 344-351	39	38 ± 10.9 (F)	-	0 (M) / 39 (F)
3	RCT	Abrahamsen et al.	J Pain 2008 Aug; 136(1-2): 44-52	41	56 ± 1.9 (M+F)	-	6 (M) / 35 (F)
4	RCT	Abrahamsen et al.	J Pain 2010; 151(3): 825-833	19	40.7 ± 2.3 (M+F)	-	1 (M) / 18 (F)
5	RCT	Abrahamsen et al.	J Oral Rehab 2009; 36(8): 556-570	40	38.6 ± 10.8 (F)	-	0 (M) / 40 (F)
6	RCT	Baad-Hansen et al.	Clin J Pain 2013; 29(6): 518-526	41	56 ± 1.9 (M/F	-	6 (M) / 35 (F)
7	RCT	Eitner et al.	Int J Clinical Experimental Hypnosis 2010; 58(4): 457-475	102	41.3 (M+F) / 42.3 (M) / 40.1 (F)	-	53 (M) / 49 (F)
8	RCT	Enqvist et al.	Int J Clinical Experimental Hypnosis 1997 Apr; 45(2): 102-108	69	28.1 ± 5.79 (M+F)	-	33 (M) / 36 (F)
9	RCT	Facco et al.	Int J Clinical Experimental Hypnosis 2011; 59(4): 454-468	31	28 ± 4.6 (M+F)	-	12 (M) / 19 (F)
10	RCT	Ghoneim	Anesthesia and Analgesia; 90(1): 64-68	60	23.2 ± 3.7 (M+F)	18-35 (M+F)	25 (M) / 35 (F)
11	RCT	Huang et al.	Oral Diseases 2016; 22(8): 766-774	36	-	19-25 (M+F)	36 (M+F)
12	RCT	Huet et al.	Int J Clinical Experimental Hypnosis;	29	8.5 (M+F)	5-12 (M+F)	16 (M) /

			59(4): 424-440				13 (F)
13	RCT	Mackey	Int J Clin Exp Hypn 2010; 58(1): 21-38	91	21 (M+F)	18-25 (M+F)	45 (M) / 54 (F)
14	RCT	Mackey	Amr J Clin Hypn 2018; 60(4): 378-385	143	-	18-25 (M+F)	-
15	CT	Ramirez-Carrasco et al.	Pain Res and Management 2017 Apr; Art.-ID 1434015: 5	40	7.5 ± 1.4 (M+F)	5-9 (M+F)	16 (M) / 24 (F)
16	RCT	Oberoi et al.	J Pediatric Dent 2016 Mar/Apr; 38(2): 112-115	200	9.8 (M+F)	6-16 (M+F)	94 (M) / 106 (F)
17	CT	Sharav et al.	Brain Res 1989 Jul; 479(2): 247-254	17	25.8 (M+F)	18-38 (M+F)	-
18	RCT	Sharav et al.	Int J Psychophysiol 2004 Mar; 52(2): 187-96	15	23.2 (M+F)	21-26 (M+F)	7 (M) / 8 (F)
19	RCT	Sharav et al.	J Pain 2006 Jun; 124(3): 280-6	25	22.9 (M+F)	18-32 (M+F)	14 (M) / 11 (F)
20	RCT	Tal et al.	J Orofacial Pain 2005; 19(1): 76-81	16	23.2 (M+F)	21-26 (M+F)	8 (M) / 8 (F)
21	RCT	Wang et al.	J Oral Diseases 2015; 21(5): 572-582	24	-	18-28 (M+F)	12 (M) / 12 (F)
22	CS	Winocur et al.	J Oral Surgery Oral Medicine Oral Pathology 2002 Apr; 93 (3): 429-434	40	30.25 ± 1.48 (F)	16-49 (F)	0 (M) / 40 (F)
23	RCT	Wolf et al.	Int J clin exp hypn 2016 Feb; 64(2): 187-199	37	27.7 ± 7.85 (M+F)	21-54 (M+F)	13 (M) / 24 (F)
24	RCT	Wolf et al.	Int J clin exp hypn 2016 Sep; 64(4): 391-403	34	27.8 ± 7.97 (M+F)	21-54 (M+F)	12 (M) / 22 (F)
25	CT	Adibahanum et al. 2020	PJMHS 2020;14(2):1502-1505	34	-	17-23 (M+F)	-
26	CT	Moghadam et al. 2020	Clin Exp Dent Res 2021;7(3):399-405	32	-	18-25 (M+F)	16 (M) / 16 (F)
27	RCT	Sabherwal et al. 2021	Eur Arch Paediatr Dent 2021;3(29);1-10	60	9.75 (M+F)	8-12 (M+F)	36 (M) / 24 (F)

CCS: Case-control study**; CS:** Comparative Study; **CT**: Clinical Trial, **RCT**: Randomized Clinical Trial

(M) = Male only, **(F)** = Female only, **(M+F**) = Totale of Male and Female