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REVIEW

Optimal management of orthodontic pain

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Francielle Topolski[1]
Alexandre Moro[1,2]
Gisele Maria Correr[3]
Sasha Cristina Schimim[1]

[1]Department of Orthodontics, Positivo University, Curitiba, Paraná, Brazil; [2]Department of Orthodontics, Federal University of Paraná, Curitiba, Paraná, Brazil; [3]Department of Restorative Dentistry, Positivo University, Curitiba, Paraná, Brazil

Abstract: Pain is an undesirable side effect of orthodontic tooth movement, which causes many patients to give up orthodontic treatment or avoid it altogether. The aim of this study was to investigate, through an analysis of the scientific literature, the best method for managing orthodontic pain. The methodological aspects involved careful definition of keywords and diligent search in databases of scientific articles published in the English language, without any restriction of publication date. We recovered 1281 articles. After the filtering and classification of these articles, 56 randomized clinical trials were selected. Of these, 19 evaluated the effects of different types of drugs for the control of orthodontic pain, 16 evaluated the effects of low-level laser therapy on orthodontic pain, and 21 evaluated other methods of pain control. Drugs reported as effective in orthodontic pain control included ibuprofen, paracetamol, naproxen sodium, aspirin, etoricoxib, meloxicam, piroxicam, and tenoxicam. Most studies report favorable outcomes in terms of alleviation of orthodontic pain with the use of low-level laser therapy. Nevertheless, we noticed that there is no consensus, both for the drug and for laser therapy, on the doses and clinical protocols most appropriate for orthodontic pain management. Alternative methods for orthodontic pain control can also broaden the clinician's range of options in the search for better patient care.

Keywords: tooth movement, pain control, drug therapy, laser therapy

Introduction

Orthodontic tooth movement is a result of the application of forces to the teeth. The orthodontic forces promote tooth displacement in the periodontal ligament space, leading to the formation of areas of compression and traction. These stimuli trigger a series of tissue reactions that result in bone remodeling of the alveolus through the processes of bone resorption and apposition, thus permitting changes in tooth positioning.[1] These processes are accompanied by a stimulation of nerve endings in the periodontal ligament and an inflammatory process, which most often results in pain.[2]

Pain is one of the most important side effects of orthodontic tooth movement and one of the factors that discourage patients the most from starting orthodontic treatment. In addition, it is among the main causes for treatment withdrawal.[2–4] However, despite the relevance of pain in the clinical practice of orthodontics, this symptom is frequently underestimated and receives little attention. Considering the importance of pain control to promote patient well-being and avoid orthodontic treatment withdrawal, this study aimed to identify, through an analysis of the scientific literature, the best method for managing orthodontic pain.

Correspondence: Francielle Topolski
Universidade Positivo, Rua Professor Pedro Viriato Parigot de Souza, 5300 – Campo Comprido, Curitiba, CEP 81280-330, Brazil
Tel/fax +55 41 3317 3180
Email frantopolski@gmail.com

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Materials and methods

The methodological procedures used to conduct this research were guided by the Knowledge Development Process – Constructivist (ProKnow-C) process.[5] The research was carried out in August 2017 according to the procedure outlined in Figure 1. Initially, the most representative keywords for the studied subject were defined. The terms underwent a test of adherence, in which the results that each keyword generated when searched in databases were assessed. The keyword selection was validated by a researcher with experience in the area. The following keyword combinations were used: "tooth movement" AND pain and orthodontic* AND pain. We searched the MEDLINE via PubMed and Science Direct databases. The search was directed toward scientific articles published in the English language. There was no restriction on the date of publication.

The retrieved articles were exported using EndNote X6 software. The articles were filtered and classified using the software features. Duplicate articles were identified and deleted. The others were classified through analyses of titles, abstracts, and keywords. Scientific articles that evaluated different methods of orthodontic pain management were selected. The selected articles were subjected to a more careful classification, from which only the randomized clinical trials were retained. These studies, which correspond to the final portfolio of selected articles, were comprehensively analyzed.

Results

We recovered 1281 articles. Of these, 342 were duplicates and were excluded. The other 939 were classified on the basis of analyses of titles, abstracts, and keywords. Of these, 12 were not scientific articles and 820 were not aligned with the objective of this study. The other 107 articles were selected and subjected to a new classification, in which only randomized clinical trials were selected: 56 articles remained. Of these, 19 evaluated the effects of different types of drugs to manage orthodontic pain, 16 evaluated the effects of low-level laser therapy (LLLT), and the other 21 studies evaluated other types of intervention (Figure 2). Table 1 shows the selected articles, their general methods, and the main outcomes.

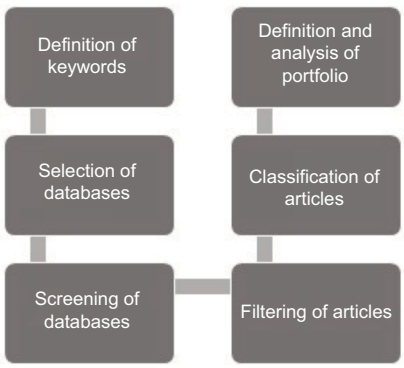

Figure 1 Methodological stages.

Systematic analysis

Drug therapy

Several studies have evaluated the effects of different types of drugs on the control of orthodontic pain. Steen Law et al[6] compared three groups of patients subjected to the insertion of elastic separators. One group used ibuprofen 1 hour before and placebo 1 hour after the procedure; another group was administered placebo 1 hour before and ibuprofen 1 hour after the procedure, and the third group received only placebo 1 hour before and 1 hour after the procedure. The group that received the drug before the separator placement experienced less pain when compared to the other groups. Bernhardt et al[7] compared the use of ibuprofen administered only before the separator placement, both before and after the separator placement, and only after the separator placement. They observed that administration before the procedure was more effective in pain control. Minor et al[8] compared a group of patients who received ibuprofen both before and after separator placement with one group that received the drug only after the procedure and with another group that received only placebo. The group receiving the drug in both the preoperative and postoperative periods had a more effective pain reduction.

Bradley et al[9] compared the effects of paracetamol and ibuprofen administered 1 hour before and 6 hours after the placement of elastic separators and concluded that ibuprofen had a greater effect on orthodontic pain control. Alqahtani et al[10] also observed that ibuprofen was more effective than paracetamol. In this study, patients were administered either paracetamol or ibuprofen after the insertion of elastic separators. Patel et al[11] observed that ibuprofen had a greater effect on orthodontic pain reduction compared to both paracetamol and naproxen sodium. In this study, patients were administered paracetamol, naproxen, or ibuprofen 1 hour before the procedure. The same drug initially administered was again administered 3 and 7 hours after the insertion of elastic separators. The group that used ibuprofen had better pain reduction when compared with the placebo group. However, the groups that used paracetamol and naproxen sodium did not present any differences in terms of pain reduction from the group that used placebo.

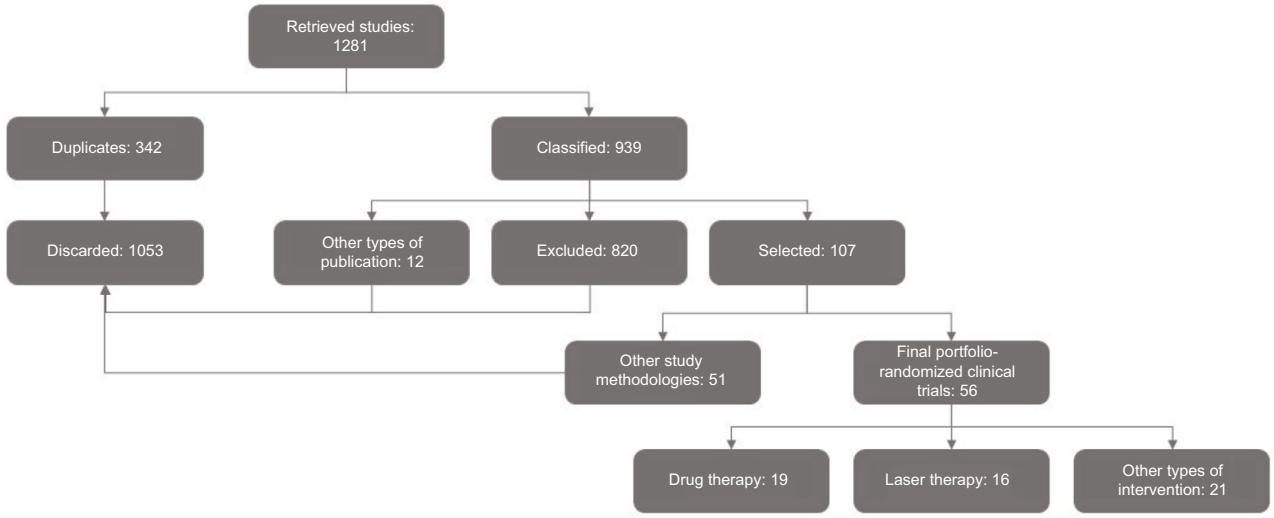

Figure 2 Flowchart of filtering and classification of articles.

Table 1 Selected articles

Author	Methods				Main outcomes
	Orthodontic intervention	Intervention for pain control	Placebo/ control group	n	
Alqahtani et al[10]	Elastic separators	Paracetamol (500 mg) every 6 hours for 3 days or ibuprofen (400 mg) every 8 hours for 2 days	Yes	90	Ibuprofen was more effective in pain control
Arantes et al[24]	Canine tooth retraction	Tenoxicam (20 mg) in daily doses for 3 days; first dose before or after OI	Yes	36	Tenoxicam was effective in pain control; there was no preemptive effect
Bernhardt et al[7]	Elastic separators	Ibuprofen (400 mg) 1 hour before, 6 hours after or 1 hour before and 6 hours after OI	No	41	Ibuprofen taken 1 hour before OI was more effective
Bird et al[17]	Elastic separators	Paracetamol (650 mg) or ibuprofen (400 mg) 1 hour before OI	No	33	There was no difference for pain between the two drugs
Bradley et al[9]	Elastic separators	Paracetamol (1 g) or ibuprofen (400 mg) 1 hour before and 6 hours after OI	No	159	Ibuprofen was more effective in pain control
Bruno et al[21]	Elastic separators	Lumiracoxib (400 mg) 1 hour before OI	Yes	51	There was no difference in pain between the experimental, placebo, and control groups
Gupta et al[20]	First orthodontic arch activation	Paracetamol (500 mg) thrice daily or etoricoxib (60 mg) once daily; first dose 1 hour before OI; given until day 3	Yes	45	Etoricoxib was more effective in pain control
Hosseinzadeh et al[16]	Elastic separators	Paracetamol (650 mg) or ibuprofen (400 mg) 1 hour before OI and every 6 hours afterward (five doses in total)	Yes	101	Paracetamol and ibuprofen were more effective than placebo; there was no difference between the two drugs
Kholi V and Kohli S[23]	Elastic separators	Ibuprofen (400 mg) or piroxican (20 mg); 1 hour before OI	Yes	90	Piroxican was more effective in pain control
Minor et al[8]	Elastic separators	Ibuprofen (400 mg) 1 hour before, 3 and 7 hours after OI or ibuprofen (400 mg) 3 and 7 hours after OI	Yes	51	Ibuprofen taken 1 hour before OI was more effective in pain control
Patel et al[11]	Elastic separators	Paracetamol (650 mg), ibuprofen (400 mg) or naproxen sodium (500/250 mg); 1 hour before, 3 and 7 hours after OI	Yes	24	Ibuprofen was more effective in pain control
Polat et al[12]	First orthodontic arch activation	Paracetamol (500 mg), ibuprofen (400 mg), flurbiprofen (100 mg), naproxen sodium (550 mg), or aspirin (300 mg)	Yes	150	Naproxen sodium, aspirin, and paracetamol were more effective in pain control

(*Continued*)

Table 1 (*Continued*)

Author	Methods				Main outcomes
	Orthodontic intervention	Intervention for pain control	Placebo/ control group	n	
Polat and Karaman[13]	First orthodontic arch activation	Ibuprofen (400 mg) or naproxen sodium (550 mg); 1 hour before OI	Yes	60	Naproxen sodium was more effective in pain control
Salmassian et al[18]	First orthodontic arch activation	Paracetamol (600 mg) or ibuprofen (400 mg); after OI	Yes	60	There was no difference in pain control between the two drugs and placebo
Steen Law et al[6]	Elastic separators	Ibuprofen (400 mg) 1 hour before or 1 hour after OI	Yes	63	Ibuprofen taken 1 hour before OI was more effective in pain control
Sudhakar et al[14]	Elastic separators	Paracetamol (650 mg), ibuprofen (400 mg), or aspirin (300 mg); 1 hour before and 6 hours after OI	Yes	154	Aspirin was more effective in pain control, followed by ibuprofen and paracetamol
Tunçer et al[19]	First orthodontic arch activation	Paracetamol (500 mg) or ibuprofen (400 mg)	Yes	48	There was no difference in pain control between the two drugs and placebo
Yassaei et al[15]	First orthodontic arch activation	Paracetamol (325 mg) or calcium (500 mg)	No	40	Calcium was more effective in pain control
Zarif Najafi et al[22]	Elastic separators	Paracetamol (650 mg), ibuprofen (400 mg), or meloxicam (7.5 mg); 1 hour before OI	No	321	There was no difference between the evaluated drugs
Almallah et al[33]	Elastic separators	LLLT; single or double dose	Yes	36	LLLT was more effective than placebo; there was no difference between single and double dose
AlSayed et al[32]	Elastic separators	LLLT; 2 or 4 J/cm^2	Yes	26	There was no difference for pain between the experimental groups and placebo
Artés-Ribas et al[26]	Elastic separators	LLLT	Yes	20	LLLT was effective in pain control
Bayani et al[40]	First orthodontic arch activation	Ibuprofen (400 mg), bite wafer, low-level red laser, or low-level infrared laser	Yes	100	Low-level infrared laser was more effective in pain control
Bicakci et al[39]	Band placement	LLLT	Yes	19	LLLT was effective in pain control
Dalaie et al[36]	Canine tooth retraction	LLLT	Yes	12	There was no difference in pain between the experimental and control groups
Dominguez and Velásquez[38]	Final orthodontic arch activation	LLLT	Yes	60	LLLT was effective in pain control
Doshi-Mehta and Bhad-Patil[34]	Canine tooth retraction	LLLT	Yes	20	LLLT was effective in pain control
Eslamian et al[31]	Elastic separators	LLLT	Yes	37	LLLT reduced pain in the first 3 days after OI
Farias et al[30]	Elastic separators	LLLT	Yes	30	LLLT was effective in pain control
Holmberg et al[25]	Elastic separators	LLLT	Yes	30	LLLT was effective in pain control
Kim et al[27]	Elastic separators	LLLT or LED therapy	Yes	88	LLLT was effective in pain control
Marini et al[29]	Elastic separators	LLLT	Yes	120	LLLT was effective in pain control
Nóbrega et al[28]	Elastic separators	LLLT	Yes	60	LLLT was effective in pain control
Sobouti et al[35]	Canine tooth retraction	LLLT	Yes	34	LLLT was effective in pain control
Tortamano et al[37]	First orthodontic arch activation	LLLT	Yes	60	LLLT was effective in pain control
Bartlett et al[41]	First orthodontic arch activation	Structured telephone call or attention-only telephone call	Yes	150	A telephone call reduced pain; the content of the telephone call was not important

(*Continued*)

Table 1 (*Continued*)

Author	Methods				Main outcomes
	Orthodontic intervention	Intervention for pain control	Placebo/ control group	n	
Benson et al[43]	First orthodontic arch activation	Chewing gum	Yes	57	Chewing gum was effective in pain control
Cozzani et al[42]	First orthodontic arch activation	Structured text message or structured telephone call	Yes	84	Both experimental groups had less pain than the control group; telephone call was more effective in pain control
Eslamian et al[45]	Elastic separators	Benzocaine mucoadhesive patches (20%)	Yes	30	Benzocaine mucoadhesive patches were effective in pain control
Eslamian et al[46]	Maxillary en masse orthodontic space closure	Topical benzocaine (5%) or ketoprofen (1.60 mg/mL)	Yes	20	Ketoprofen was more effective in pain control, followed by benzocaine and placebo
Eslamian et al[47]	Fixed orthodontic appliance activation	Benzocaine gel (5%)	Yes	30	Benzocaine gel was effective in pain control
Eslamian et al[48]	Elastic separators	Naproxen gel (5%)	Yes	41	Naproxen gel was effective in pain control
Esper et al[58]	Elastic separators	LLLT or low-level LED therapy	Yes	55	LED was effective in pain control
Farzanegan et al[59]	First orthodontic arch activation	Ibuprofen (400 mg), viscoelastic bite wafers or chewing gum; immediately after OI and every 8 hours in the case of pain	Yes	50	Viscoelastic bite wafers and chewing gum were effective in pain control
Huang et al[53]	First orthodontic arch activation	Brainwave music, cognitive behavioral therapy, or established psychotherapy	Yes	36	Brainwave music was effective in pain control
Ireland et al[60]	First orthodontic arch activation/ change	Chewing gum and ibuprofen in the case of pain or only ibuprofen	Yes	1000	The use of chewing gum reduced the consumption of ibuprofen
Lobre et al[55]	Elastic separators/ fixed orthodontic appliance activation	Vibrational device	Yes	58	Vibrational device was effective in pain control
Miles et al[56]	Fixed orthodontic appliance activation	Vibrational device	Yes	66	Vibrational device was not effective in pain control
Murdock et al[61]	First orthodontic arch activation	Bite wafer or over-the-counter analgesics	No	69	Bite wafer was as effective as over-the-counter analgesics in pain control
Otasevic et al[44]	First orthodontic arch activation	Bite wafer or avoidance of mastication	No	84	More pain was reported by patients using bite wafers
Sawada et al[49]	Elastic separators	Cognitive behavioral therapy	Yes	32	Cognitive behavioral therapy was effective in pain control
Wang et al[50]	First orthodontic arch activation	Cognitive behavioral therapy or ibuprofen	Yes	450	Cognitive behavioral therapy was effective in pain control
Wang et al[51]	First orthodontic arch activation	Cognitive behavioral therapy or ibuprofen	Yes	24	Cognitive behavioral therapy was effective in pain control
Woodhouse et al[57]	Fixed orthodontic appliance activation	Vibrational device	Yes	81	Vibrational device was not effective in pain control
Xu et al[54]	First orthodontic arch activation	Music	Yes	165	Music was effective in pain control
Zheng et al[52]	First orthodontic arch activation	Cognitive therapy, music therapy, muscle relaxation, or suggestion therapy	Yes	300	Cognitive therapy, music therapy, muscle relaxation, and suggestion therapy were effective in pain control

Abbreviations: LED, light-emitting diode; LLLT, low-level laser therapy; OI, orthodontic intervention.

In contrast, Polat et al,[12] when comparing the effects of ibuprofen and naproxen sodium administered separately 1 hour before orthodontic arch activation, found that naproxen sodium was more effective in pain control. In another study, Polat and Karaman[13] compared the effects of ibuprofen, flurbiprofen, paracetamol, naproxen sodium, and aspirin. The authors reported that all the drugs used were more effective compared to the placebo; however, naproxen sodium, aspirin, and paracetamol yielded better results.

Sudhakar et al[14] compared the effects of paracetamol, ibuprofen, aspirin, and placebo initially administered 1 hour before the insertion of elastic separators and every 6 hours after the insertion of elastic separators. They reported that all drugs had effects superior to placebo and that the best results were observed in the group that used aspirin, followed by the group that used ibuprofen. Paracetamol generated less pain reduction compared to the other drugs tested. Yassaei et al[15] observed that calcium was more effective for orthodontic pain control than paracetamol.

Hosseinzadeh et al[16] compared the effects of paracetamol and ibuprofen administered 1 hour before the insertion of elastic separators and every 6 hours after their insertion. The authors concluded that there was a reduction in pain perception in both groups compared to placebo. There was no difference in pain reduction between the groups that were administered the two drugs, as reported by the patients. Bird et al[17] also compared the effects of paracetamol and ibuprofen administered 1 hour prior to separator placement. The authors did not observe a difference between the two groups. In this study, no control group was used. Two other studies[18,19] reported no difference in orthodontic pain with paracetamol, ibuprofen, or placebo administration.

The other drugs tested were etoricoxib, lumiracoxib, meloxicam, piroxicam, and tenoxicam. Gupta et al[20] compared the effects of administration of paracetamol, etoricoxib, and placebo 1 hour before and 3 days after the first orthodontic arch was installed. They concluded that etoricoxib was more effective in reducing pain. Bruno et al[21] evaluated the effect of lumiracoxib administered 1 hour before the separator insertion. They did not observe a difference in pain perception between the group that was treated with the drug and the group that was administered placebo. Zarif Najafi et al[22] compared the effects of paracetamol, ibuprofen, and meloxicam administered 1 hour before the separator insertion. The authors did not observe a difference in efficacy among the tested drugs. In this study, no control group was used. Kholi and Kohli[23] evaluated the effects of ibuprofen and piroxicam administered 1 hour prior to the insertion of elastic separators. The authors observed that piroxicam was more effective in pain control than ibuprofen. Arantes et al[24] evaluated tenoxicam administered to one group before the activation of the device to upper canine retraction and to another group after the procedure. The effects of these drugs were then compared with the placebo. The authors reported that the tenoxicam-treated groups had less pain than the placebo group, regardless of the time of administration.

Laser therapy

The reduction in pain perception after insertion of elastic separators by the effect of LLLT was reported by Holmberg et al,[25] Artés-Ribas et al,[26] Kim et al,[27] Nóbrega et al,[28] Marini et al,[29] and Farias et al.[30] Eslamian et al[31] observed that the application of LLLT was effective in reducing pain during the first 3 days after separator insertion. After this period, the pain was of low intensity and presented marked variation in both the treatment and control groups. AlSayed et al[32] did not observe a reduction in orthodontic pain after insertion of elastic separators by the effect of LLLT.

Almallah et al[33] tested the effect of LLLT after separator insertion by comparing a protocol with a single application, which was administered immediately after separator insertion, and another with double application, which was administered immediately after the separator insertion and once again after 24 hours. The authors reported that LLLT was effective in reducing pain, with no significant differences between the single and double application protocols.

Other studies have evaluated the effect of LLLT on orthodontic pain during canine retraction. Doshi-Mehta and Bhad-Patil[34] observed an average increase of 30% in the rate of tooth movement, as well as a reduction in pain perception in patients subjected to laser application. A positive effect on pain reduction was also reported by Sobouti et al.[35] Dalaie et al,[36] on the contrary, did not observe any differences either with the movement rate or with the pain perception when compared to control group.

Tortamano et al[37] evaluated the effect of LLLT after insertion of the first orthodontic arch, while Dominguez and Velásquez[38] evaluated the effect of LLLT after activation of the final orthodontic arch. Both reported reductions in orthodontic pain in patients subjected to laser application. Bicakci et al[39] observed that LLLT after activation of the fixed appliance led to a reduction both in the perceived pain by patients and in the levels of prostaglandins expressed in the crevicular fluid.

Bayani et al[40] compared the effects of ibuprofen, bite wafer, low-level red laser, and low-level infrared laser on orthodontic pain after activation of the first orthodontic arch. They concluded that low-level infrared laser was more effective in pain control.

Other methods of orthodontic pain control

Some studies have evaluated other methods of orthodontic pain control. Bartlett et al[41] and Cozzani et al[42] found that a telephone call from the dental office after consultation

might be effective in reducing orthodontic pain. Benson et al[43] observed a positive effect of using chewing gum on orthodontic pain control. Otasevic et al[44] reported a reduction in orthodontic pain with the use of bite wafers.

Some studies have tested the use of topical drugs. Eslamian et al[45] observed that the use of benzocaine mucoadhesive plaster (20%) reduced pain due to the insertion of an elastic separator. Eslamian et al[46] found that topical application of 5% benzocaine gel and ketoprofen (1.60 mg/mL) reduced the pain resulting from loop activation for mass dental retraction. In this study, the ketoprofen gel was more effective than the benzocaine gel. Eslamian et al[47] also reported a reduction in orthodontic pain with the application of 5% benzocaine gel. Eslamian et al[48] observed a reduction in pain due to the insertion of an elastic separator in patients who were treated with topical application of naproxen 5%.

Cognitive behavioral therapy was a method identified as effective in controlling orthodontic pain by Sawada et al,[49] Wang et al,[50,51] and Zheng et al.[52] The latter also reported positive results with music therapy, muscle relaxation therapy, and suggestion therapy. The positive effect of music on orthodontic pain reduction was also reported by Huang et al[53] and Xu et al.[54]

Studies have also evaluated the influence of vibratory devices on orthodontic pain control. Lobre et al[55] and Miles et al[56] reported positive results of pain reduction, whereas Woodhouse et al[57] did not observe any difference between patients undergoing therapy with this type of device and the control group during the initial orthodontic alignment.

Esper et al[58] verified that low-level light-emitting diode therapy was more effective than LLLT in orthodontic pain control after insertion of orthodontic separator.

A few studies have compared the efficacy of drugs with that of nonpharmacologic methods with respect to pain control. Farzanegan et al[59] compared the use of ibuprofen, soft viscoelastic bite wafer, hard viscoelastic bite wafer, chewing gum, and placebo administered immediately after and then every 8 hours in the case of pain after the initial orthodontic arch was installed. The authors concluded that ibuprofen might be replaced by nonpharmacologic methods tested for orthodontic pain control. Ireland et al[60] found that the use of chewing gum might reduce the consumption of ibuprofen for orthodontic pain control. Murdock et al[61] reported that the use of bite wafer after the initial orthodontic arch insertion was as effective as the consumption of analgesics in the control of orthodontic pain.

Discussion

This study aimed to investigate the best methods of orthodontic pain control. The methodological strategy used was the review of scientific literature oriented by the Knowledge Development Process – Constructivist (ProKnow-C).[5] This process involves the careful selection of keywords as well as a thorough search of databases pertinent to this study. The cross-checking of keywords guarantees the specificity of the search with respect to the research topic.

The analysis of the final portfolio of articles revealed that studies evaluating different types of medications for orthodontic pain control were the most prevalent. The most frequently searched drugs were ibuprofen and paracetamol. The results of the studies comparing the effects of these two drugs on orthodontic pain control have been quite contradictory. A few studies showed that ibuprofen was more effective,[9–11,14] while another study presented that paracetamol produced better results in terms of pain control.[13] A few other studies posited that there is no difference between them in terms of pain reduction[16,17] and that neither is effective in the control of orthodontic pain.[18,19] A few studies suggested that the preemptive effect of ibuprofen was more important than its postoperative administration.[6–8]

Patel et al[11] observed that ibuprofen had a greater effect on orthodontic pain compared to naproxen sodium, in contrast to the study by Polat et al,[12] who observed that naproxen sodium was more effective than ibuprofen. The efficacies of aspirin,[13,14] etoricoxib,[20] meloxicam,[22] piroxicam,[23] and tenoxicam[24] were also evaluated; these drugs were found to be effective in reducing orthodontic pain. Lumiracoxib, however, was not effective.[21]

The studies that involved the administration of these drugs presented a great variability, not only in terms of the results found but also in terms of the methodology used. Studies with ibuprofen consistently used a 400 mg dose. However, there was a substantial variation in terms of dose with respect to the other drugs. The drug administration protocols were also quite varied, as were the periods of pain data collection.

Studies evaluating the effect of LLLT on the control of orthodontic pain also presented considerable variations in relation to the design, type, and protocol of laser application. The majority of such studies, however, reported favorable results.[25–31,33–35,37–40]

In addition to drug administration and laser therapy, other methods of orthodontic pain control have been researched and shown to be effective. It is worth noting that a telephone call from the dental office after consultation,[41,42] topical application of benzocaine and ketoprofen,[45–48] cognitive behavioral therapy,[49–52] muscle relaxation,[52] suggestion therapy,[52] music,[52–54] vibratory devices,[55,56] chewing gum,[43,59,60] and bite wafers[59,61,44] have all been shown to be effective in terms of orthodontic pain control.

Different methods of inducing tooth movement were used in the studies, including the use of separators, canine retraction, and dental alignment with fixed appliance. These methods can generate different intensities of force and, consequently, different intensities of pain, which make it difficult to compare the results. The individual variability and subjectivity inherent in the study of pain are also limiting factors in this type of research. Studies, in general, do not present details about the patients' initial malocclusion.

Most of the studies used a visual analog scale as a method to assess pain. However, a great variation was observed in relation to the moment when the pain was evaluated, specifically in relation to the time periods after orthodontic intervention and to the activity the patient was performing during pain assessments.

Some studies evaluated the effect of interventions for pain relief on tooth movement. Arantes et al[24] did not observe the influence of tenoxican administration on tooth movement. Dalaie et al[36] also did not observe differences related to tooth movement with LLLT application. Miles at al[56] found that the vibratory device used, besides not promoting pain relief, did not influence tooth movement. On the contrary, Doshi-Mehta and Bhad-Patil[34] observed that the application of LLLT, in addition to reducing pain, promoted an increase in the rate of tooth movement.

Most of the studies used samples of adolescents from both sexes. Some of them also included adults. There were no differences in pain perception related to the age group. Cozzani et al[42] reported that female subjects appeared to be more sensitive to pain than male subjects. Xu et al[54] observed a greater effect on pain relief for the male subjects than for the female subjects.

Conclusion

Analysis of the scientific literature allows us to conclude that the main methods of orthodontic pain control are drug administration and the application of LLLT.

With respect to drug administration, positive results were obtained in terms of pain control with the use of ibuprofen, paracetamol, naproxen sodium, aspirin, etoricoxib, meloxicam, piroxicam, and tenoxicam. Nevertheless, there is no consensus on the most effective dose and the protocol to be used.

With respect to LLLT, although most studies report favorable results in terms of pain reduction, there is a need to establish an ideal clinical protocol.

Alternative nonpharmacologic methods for orthodontic pain control are also effective and can broaden the clinician's range of options in the search for better patient care.

Disclosure

The authors report no conflicts of interest in this work.

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