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The effects of cognitive behavioral therapy on experimental orthodontic pain

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ABSTRACT

Purpose: To evaluate the effectiveness of cognitive behavioral therapy (CBT) for subjects with experimental orthodontic pain.

Materials and methods: Thirty-two healthy adult volunteers (mean age of 24.8 years) were recruited and randomized into two groups: CBT intervention group (CBT group; $n = 16$) and no intervention group (control group; $n = 16$). Subjects had no spaces in a row of teeth, and contact between the second bicuspid tooth and first molar tooth of upper jaw of both sides could tolerate insertion of a contact gauge (50–110 μm). Elastic separators were inserted between both sides of the second bicuspid tooth and first molar tooth of the upper jaw. CBT was conducted in the CBT group immediately and 1 day after insertion with a CBT operator, and 2–7 days after insertion by the subjects themselves. Pain evaluation was assessed using the methods of magnitude estimation and visual analog scales were carried out as rating scales. All evaluations were conducted before, immediately after, 1 day, and 7 days after insertion of the separator.

Results: In the standardized scores of magnitude estimates of pain, the scores of the CBT group immediately after insertion were significantly higher than those of the control group. Scores of the CBT group 1 day after insertion were significantly lower than those of the control group.

Conclusion: CBT was shown to be effective in the management of orthodontic pain and could merit clinical application.

1. Introduction

In subjects who have undergone orthodontic procedures, discomfort and pain are common. Reports have stated that more than 90% of patients feel pain during orthodontic treatments [1–6]. Various methods of reducing pain (e.g., medication, laser irradiation) have been studied by several researchers [7–13].

Two types of pain can be observed when undergoing orthodontic treatment. Pain can arise immediately after applying orthodontic force (“immediate pain”), or arise 1

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day after treatment and be maintained for several days to 1 week (''late pain'') [14,15]. Immediate pain is recognized as nociceptive pain arising due to compression of periodontal membranes. Late pain is recognized as inflammatory and neuropathic pain due to the production of inflammatory materials, remodeling of nerve endings, caused by tooth movement. Animal experiments have shown that pain-related substances because of teeth movement are expressed in two steps in the brain. Expression of pain-related substances increased in the cerebral limbic cortex (amygdala, hypothalamus) 24 h after teeth movement in rats. These findings suggest that late pain could be associated with emotional factors [14–17].

The effects of cognitive behavioral therapy (CBT) for managing pain have been investigated. CBT has been said to influence the pain relevant to emotions [18]. Traditionally, CBT has been used for the treatment of depression, anxiety, and fear in psychiatric/psychological specialties.

Recently, it is being actively researched in treatments for lumbago, chronic pain (e.g., rheumatism) and end-stage cancer [18–22]. It has become apparent that adaptation to pain differs according to negative or positive perceptions.

In addition, a report from China stated that pain in orthodontic patients could be reduced by CBT [23]. However, the orthodontic force applied is dependent upon the subject, and the pain intensity could be different between studies. To evaluate the effect of CBT more accurately, research experiments with controlled correction forces are required. Hence, we sought to clarify the pain state and influence of CBT for pain caused by orthodontic forces in Japanese subjects.

2. Materials and methods

2.1. Subjects

The study protocol was approved by the Ethics Committee of Tokyo Medical and Dental University (Tokyo, Japan). All participants were fully informed of the risks associated with the study and provided written informed consent.

Thirty-two healthy adult volunteers (mean age ± standard deviation = 24.8 ± 2.7 years) were recruited and randomized into two groups: CBT intervention group (CBT group; $n = 16$), and no intervention group (control group; $n = 16$). Each group comprised 8 males and 8 females. All subjects had no spaces in a row of teeth. Contact between the second bicuspid tooth and first molar tooth of the upper jaw of both sides was such that a contact gauge (50–110 μm) could be inserted. Then, elastic separators were inserted between the both sides of the second bicuspid tooth and first molar tooth of the upper jaw.

2.2. Subjective estimation of pain

Pain was assessed using method of magnitude estimation and visual analog scale (VAS), and participants could comment about the pain they felt on the evaluation form. Pain was estimated at three scenarios: at rest; upon tapping of the tooth; and at clenching. All evaluations were conducted before, immediately after, 1 day after, and 7 days after insertion of the separator.

In the method of magnitude estimation, we asked subjects to ascribe a number to the pain they felt without using a stimulus called the modulus as a standard (the method of modulus-free magnitude estimation). In the first evaluation, the subject fitted the most plausible number, and then fitted number that reflects the subjective impression of the subject subsequently. There is no limit to the range of numbers, and the ratio of the number and strength of feeling for each stimulus was then matched.

With respect to the VAS, subjects were asked to mark a 100-mm line at a point representing the severity of their pain. The distance of the mark from the end of the scale was taken to represent pain severity. The left end of the scale was ''no pain'' and the right end of the scale was ''pain as bad as it could be''. The VAS was scored by measuring (in mm) from the left-hand end of the line to the vertical mark made by the patient in response to each question.

2.3. CBT

The CBT group underwent CBT along with pain estimation. CBT was carried out according to a standard method [23] used in clinical psychology [20,21,24,25]. Briefly, the operator introduced herself, explained the experiment carefully, and then established rapport and trust with the subject.

The cognitive approach involved four main steps. First, the operator listened to the pain experienced by the subject. He ascertained when the participant felt stress, whether he/she had strong pain experiences, and how he/she felt the pain. The operator wanted to understand the subject's attitude to pain. Third, if most subjects had negative attitudes to pain, then the operator considered the benefits of pain, and tried to put it in a positive light. Finally, the operator tried to make the subjects understand that the past experience and recognition of pain affected recognition of the pain at the present time, and how to convert the recognition. The behavioral approach involved two steps. That is, to ask the participant to: (i) take two deep breaths and (ii) relax the muscles in the face, neck, shoulders, chest, abdomen, arms, legs, and feet.

At the end of the first CBT session, the operator ensured that all the information was recorded and summarized the session to the subject. CBT was carried out on subjects with the operator immediately and 1 day after insertion of the separator. CBT was conducted by the subjects themselves 2–7 days after insertion of the separator. Subjects recorded their perception of the therapy on the prescribed form.

2.4. Statistical analyses

Magnitude estimation score and VAS data were standardized within each subject (Z-scores). Standardized scores were analyzed for each statement (rest, tapping, clenching) separately using two-way analysis of variance (ANOVA) with the factors of intervention (CBT, control) and period (before, immediately after, 1 day after, and 7 days after separator insertion). Raw data were analyzed in the same way. If the interaction of two factors was significant, then tests of simple main effects were carried out. All effects were tested at a significance level of 0.05.