# The Effect of a New Type of Video Glasses on the Perceived Intensity of Pain and Unpleasantness Evoked by a Cold Pressor Test

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The aim of the study was to evaluate whether distraction induced by a new generation of video glasses (I-Glasses™, Virtual i-O™, Seattle, WA) has an effect on the perceived intensity of pain and unpleasantness. The effects of three-dimensional video, two-dimensional video, and no video glasses (control) were compared in two groups of healthy volunteers (13 males and 11 females) in a randomized, controlled trial. A cold pressor stimulus (1–2°C chilled water) was used to induce experimental pain, and the volunteers rated the intensity of pain and unpleasantness on 100-mm visual analogue scales. The ratings were statistically compared using the Wilcoxon signed-rank test. Between the groups (males and females), there was a significant difference ($P < .01$) in the rating of unpleasantness in the three-dimensional video condition, while there were no significant differences between the genders in the other conditions (two-dimensional, control). Three-dimensional video provided a significant reduction in both pain and unpleasantness ($P < .01$) compared with the control condition in the male group. However, in the female group, there was a significant reduction in unpleasantness with two-dimensional video compared with the control ($P < .05$). This suggests that the use of distraction by means of video glasses is able to reduce the perceived intensity of pain and unpleasantness.

**Key Words:** Cognitive pain modulation; Sound; Movie; Distraction; Cold pressor; Video glasses.

Distraction and attention can exert a powerful influence on the perceived intensity of painful stimuli. Previous studies on modulation of pain and unpleasantness have documented the effect of showing movies and have demonstrated that humor, repulsive scenes, as well as tragedy can increase pain tolerance.[1–3] Furthermore, visual distraction with the use of a kaleidoscope has been shown to possess a pain-reducing effect in children undergoing venipuncture.[4] In connection with dental procedures, the use of video games and video comedy programs has been shown to distract dental patients.[5] Music and noise have been used and tested as a method of reducing pain, but these studies have not yet given a clear picture of the effect.[6–8] A recent study has indicated lower pain threshold and tolerance among females compared with males during thermal stimuli.[9]

A new audio-visual equipment, ie, video glasses, which have been developed for virtual reality purposes, has the capability of showing three-dimensional (3D) as well as traditional two-dimensional (2D) movies. The sound is transmitted through incorporated headphones held together in a headset. This gives a unique chance to use video and music simultaneously as distraction during dental treatment, a possibility that has not previously been explored. As an experimental pain model, the cold pressor test has been chosen because it provides a standardized and relatively strong pain stimulus and has

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been widely used.[1,3,10–14] Visual analogue scales (VASs) have become one of the standards used to measure the perceived intensity of pain and unpleasantness.[1,10–12,14,15]

Thus, the aim of this study was to evaluate whether distraction induced by 3D or 2D video transmitted through video glasses has an effect on the perceived intensity of pain and unpleasantness evoked by a cold pressor stimulus.

The specific null hypotheses to be tested were $H_1$, that there would be no effect on pain/unpleasantness intensity watching 3D film compared with no video glasses during a cold pressor test; $H_2$, that there would be no effect on pain/unpleasantness intensity watching 2D film compared with no video glasses during a cold pressor test; and $H_3$, that there would be no differences between males and females in the effect of video glasses.

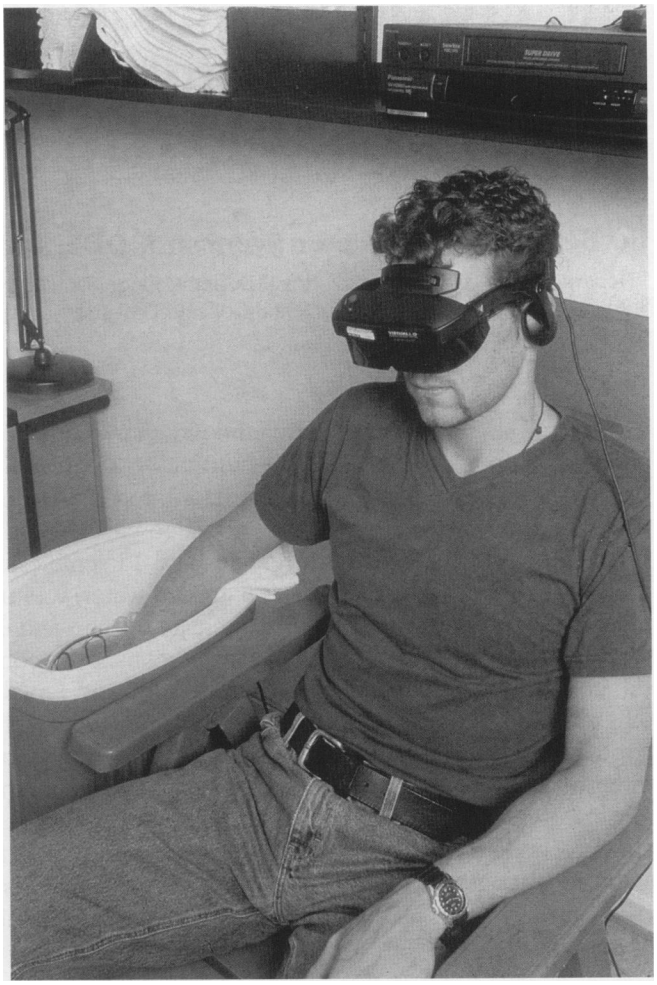
## METHODS

### Subjects

Thirteen healthy male undergraduate students were enrolled as one group and 11 female undergraduate students entered the study as another group. They were recruited by bill posting. All of the volunteers were healthy and used no medication. They had no previous experience with video glasses or cold pressor pain. The effect of video glasses was explained to the participants using the following neutral information: "Video glasses are today used widely for amusement of dental patients. Preliminary studies have shown a decrease in the feeling of unpleasantness among approximately half of these patients." The cold pressor test and the experimental set-up were explained in writing, and students were informed that they could stop the experiment at any time. Written informed consent was obtained according to the Helsinki Declaration. The mean age (±SD) for the male group was 23.7 years (±3.3; range 21–33 years) and for the female group was 24.5 years (±2.1; range 23–30 years).

### Equipment

The cold pressor equipment consisted of a cold-water tank with a water temperature of 1–2°C. In the center of the tank was placed a perforated cylinder that separated the ice from the water inside the cylinder, allowed the water to circulate freely, but avoided direct skin contact with the ice. The video equipment consisted of a video recorder (NV-HD 660 Panasonic™) connected to a pair of video glasses (I-Glasses™, Virtual i-O™, Seattle, WA) used to transmit the video to the volunteer (the Figure). A 3D video sequence showing roller skaters and a comparable 2D video sequence were used.



Subject wearing video glasses (photo: AV, Royal Dental College, Aarhus, Denmark).

### Experimental Design

The study was designed as a controlled, randomized experiment. The study consisted of three trials using 3D, 2D, and no video glasses (control). The subjects were randomized prior to the experiment to start with either 3D, 2D, or no glasses. The volunteer was placed in a comfortable chair beside the cold water tank, the video glasses were mounted, and a test was conducted to ensure optimal reception of picture and sound from the video sequence. The volunteer immersed the left hand completely into the water tank. The left hand was used for immersion every time, as a previous study has shown that there is no difference in pain ratings using either the dominant or nondominant hand during a cold pressor test.[12] The hand was not strapped, allowing the volunteer to withdraw the hand if the sensation became

**Table 1.** Median and Range for VAS Scores of Pain and Unpleasantness for Males and Females

| | *Males (N = 13)* | | *Females (N = 11)* | |
|---|---|---|---|---|
| | *Pain* | *Unpleasantness* | *Pain* | *Unpleasantness* |
| Three-dimensional video | 23 (5–73)* | 23 (12–71)* | 50 (1–78) | 50 (35–89) |
| Two-dimensional video | 42 (2–83) | 31 (12–83) | 38 (10–70) | 42 (16–73)† |
| Control | 48 (0–88) | 40 (13–82) | 45 (12–98) | 48 (16–70) |

* $P < .01$ compared to the control condition.
† $P < .05$ compared to the control condition.

unbearable. After 3 minutes (or sooner if the sensation was unbearable), the volunteer withdrew the hand and was allowed to dry it with a towel. When the volunteer indicated that the hand had returned to its normal temperature, the next trial was performed. The intertest period was a minimum of 15 minutes, during which the volunteer was allowed to exercise the hand and warm it with a hair dryer. Immediately after each cold pressor test was completed, the volunteers scored their perceived pain intensity and unpleasantness on 100-mm VASs. The VASs were labeled with the statements "not at all painful" and "extremely painful" or "not at all unpleasant" and "extremely unpleasant" at either end. After the third trial, the volunteers were finally asked which of the three options, ie, 3D video, 2D video, or no video, they would prefer if they had to participate in another cold pressor test. The volunteers were not told of any positive effect of the video glasses, and they were not able to manipulate the picture quality nor to control the volume of the music after the adaptation period. The experimenter was present in the room during the trials in order to monitor the subjects but did not communicate with them.

### Statistics

Within each group (males and females), the VAS scores for each trial were compared by the Wilcoxon signed-rank test. The groups were compared using the Mann-Whitney *U* test for differences in VAS scores between genders. $P < .05$ was accepted as a significant difference.

**Table 2.** Answers to the Question "If you were going to repeat the cold pressor test, would you prefer it with 2D video, 3D video, or without video?"

| | *Males (%) (N = 13)* | *Females (%) (N = 11)* |
|---|---|---|
| Three-dimensional video | 61.5 | 36.4 |
| Two-dimensional video | 30.8 | 54.5 |
| Video, but no preferences | 7.7 | 9.1 |
| No video | 0.0 | 0.0 |

## RESULTS

None of the volunteers withdrew their immersed hand before the fixed time period of 3 minutes had been completed. The medians for the VAS scores for the three methods are shown in Table 1. In the male group, 3D video produced a statistically significant reduction in pain and unpleasantness compared with the control condition ($P < .01$), whereas there was no significant effect of 2D video. In the female group, there was a significant reduction of unpleasantness using the 2D video compared with the control ($P < .05$); no other significant effects were seen in the female group. Between the groups (males and females), there was a significant difference ($P < .01$) in the rating of unpleasantness in the 3D video condition, while there were no significant differences between genders in the other conditions (2D, control).

Table 2 shows the result of the question "If you were going to participate in another cold pressor test, would you prefer 2D video, 3D video, or no video?" Of the volunteers who rated the 3D condition as the one causing the most pain reduction, 73% stated that the 3D would be the preferred method if they were to repeat the test again. Of the volunteers who had rated 2D as the least painful condition under which to undergo a cold pressor test, 75% preferred the 2D method if they were to participate again. None of the volunteers stated that they would prefer to repeat the test without video glasses.

## DISCUSSION

In the literature, various distraction techniques have been shown to raise the pain threshold.[2–4,6–8,16] As an experimental pain model, the cold pressor test has been widely used since it provides a standardized and relatively intense pain stimulus. If a significant effect on the perceived intensity of pain can be observed in a relatively small number of volunteers (10–15)[10,11] with this model, the distracting technique may be suitable for further evaluation.

Pain tolerance to the cold pressor test has been shown to increase after watching a humorous movie for 30 minutes before the pain stimulus started,[17] and distraction in the form of a mental task (subtraction) has recently been demonstrated to attenuate the pain sensation evoked by short $CO_2$ laser stimuli.[18] The results of another previous study[19] indicated that it was essential for the hypoalgesic effect that, first, the volunteer had a strong belief in the positive effect of music as distraction and, second, that he/she was allowed to control the volume and thereby create a feeling of controlling the pain. A more recent study evaluated the intensity of pain during dental treatment with music used as a distraction without any prior positive information and without giving the patient the possibility of controlling the volume and reported that patients listening to music experienced a stronger feeling of control of the pain than patients in the control group.[6]

The present study aimed to investigate video glasses as an easy way of implementing external distraction. A recent study demonstrated that audio and video both transmitted through video glasses reduced intensity of symptoms during sigmoidoscopy while sound per se did not have a significant effect.[20] The interpretation of this result could be that the hypoalgesic effect is related to the intensity of the stimuli, which was the reason for including both 2D and 3D films in the present study. There was no possibility for the volunteer to manipulate the volume of sound once started or to choose favorite videos. The same film sequences were unfortunately not available in both 2D and 3D, and in the selection of the videos, weight was put on their neutral content.

The present data clearly indicated that the video glasses that transmitted 3D or 2D video and stereo sound reduced the perceived pain and/or unpleasantness from the cold pressor stimulus. Another interesting finding in the present study was the observed gender differences in the effect of video glasses ($H_3$ had to be rejected). Three-dimensional video produced a significant reduction in pain and unpleasantness in the male group compared with the control condition, whereas there was no effect for 2D video. In the female group, there was a significant reduction only of unpleasantness for the 2D video compared with the control. Thus, hypothesis $H_1$ had to be rejected with regard to the male group and $H_2$ with regard to the female group. The different findings in the male and the female groups, however, are not likely to be explained by generally lower VAS scores in males than in females since there were no significant differences in their ratings of pain and unpleasantness in the control condition. Gender differences in pain threshold have been shown predominantly to originate in the experimental pain technique,[21] but gender differences have been found by other authors using the cold pressor and other thermal test stimuli.[1,2,9] Pain tolerance could not be measured because no volunteers withdrew their hand before the fixed maximum period of 3 minutes. The present results are in agreement with the findings in a study on relaxation and distraction during dental procedures that suggested that relaxation in the form of instructions through earphones was more effective in women than in men and that distraction in the form of a video game was more effective in men than in women.[22] It must be emphasized that the male group consisted mainly of polytechnic students and the female group consisted of dental students, which could be a confounding factor. Nevertheless, it was a remarkable finding that everyone wanted to use video glasses, either 2D or 3D, if they were to repeat a cold pressor test, even if they had rated the lowest pain intensity in the condition without video glasses.

Three quarters of the volunteers actually did prefer the method in which they had rated the lowest pain intensity. It seems promising for the video glasses method that it was universally preferred by volunteers, and it seems that the individual is able to choose the method that gives the greatest relief of pain and in this way optimize the effect.

In conclusion, this study suggests that an external distraction technique, video glasses, could be effective as an easily implemented device to reduce pain and unpleasantness. Therefore, further studies may be warranted to reveal whether the effect of video glasses can be transferred to different clinical situations in dental practice.

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