

Original Article

Application of animated cartoons in reducing the pain of dressing changes in children with burn injuries

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Abstract: Background: Nonpharmacological management remains one of the central pain interventional therapies in the burn unit. VR and other distraction treatments for adults have achieved great advantages in pain relief. Methods: A within-subject study was conducted to evaluate 54 participants aged from 3 to 7. In the control group, a standard analgesic, ibuprofen, was used over the period of dressing change, whereas animated cartoons were played simultaneously in the intervention-group condition. We adopted the Wong-Baker faces pain rating scale, COMFORT scale, FLACC scale and POCIS to assess the pain rating 5 min before, during and 5 min after dressing changes, respectively. Results: Compared with the control group, FLACC scale and POCIS scores in the intervention group were not significantly different ($P>0.05$) throughout the observation period; outcomes measured using the Wong-Baker faces pain rating scale and COMFORT scale 5 min before and during dressing changes were also not different between the groups ($P>0.05$). Nevertheless, 5 min after that period, subjects in the intervention group had reduced pain behavior according to scores on the Wong-Baker faces pain rating scale (control-group scores: 7.231 ± 0.403 ; intervention-group scores: 6.026 ± 0.501 , $P<0.05$) and COMFORT scale (control-group scores: 21.602 ± 1.316 ; intervention-group scores: 19.040 ± 1.204 , $P<0.05$). Conclusion: This study supports that watching animated cartoons appears to be a practical way to ease the pain behavior of children in the burn unit after replacing wound dressings, although its effectiveness remains insufficient before and during the dressing change procedure. Significance: Conducting a thorough study and exploring the efficacy of animated cartoons in reducing the pain of dressing changes for pediatric patients may surely result in practical value, especially in developing countries.

Keywords: Animated cartoon, burn, pain behavior

Introduction

Burn injuries are not uncommon pediatric surgical accidents [1]. The latest evidence in China suggests that children victims make up 30-55% of hospitalized burn patients [2]. Skin and tissue integrity can be easily damaged by burn injuries, contributing to corresponding pathological and physiological changes in children, which in serious cases, can be fatal [3]. Debridement, as one of the primary treatment methods for burn injuries [4], turns out to be more difficult for children than adults. Worse of all, it is often accompanied by severe pain throughout the operation, which interferes with rehabilitation management to some extent. Unless the strong pain is timely and effectively controlled, it leads to sequelae related to physical and mental sequelae for children suffering from burns [5-7].

Treatment of children with burn injuries has aroused much public concern. However, standard analgesics (e.g., ibuprofen, with a dosage of 5-10 mg/kg) tend to be insufficient to meet children's needs in enduring procedural pain, with poor behavioral responses and many of adverse effects, especially for children aged 3 to 7. Therefore, an increasing number of non-pharmacological treatment techniques have emerged, and some of these approaches are confirmed to be effective in decreasing the pain, anxiety and complications related to burn injuries [8-10]. High-level and multisensory distraction methods, e.g., video game distraction (VG), virtual reality games (VR), multimodal distraction (MMD) and other nonpharmacological pain management treatments aiming for adults have achieved great advantages in pain relief [11-14]. However, because of poor physical and cognitive development, when children are taken

Table 1. Characteristics of participants are shown

	Children with burn injuries (N = 54)
Sex, No. (%)	
Male	39 (72.2)
Female	15 (27.8)
Age (years)	
Mean (SD)	5.1 (2.2)
Range	3-7
%TBSA burned	
Mean (SD)	8.5 (5.9)
Range	3-13

Abbreviation: TBSA = total body surface area. Sample characteristics contain Sex, No. (%), Age (years), %TBSA burned.

into account, these methods may cause heart rhythm acceleration, blood pressure elevation, mental fear, panic disorders, post-traumatic stress disorders, dizziness or other undesirable symptoms [15, 16]. As a consequence, we aimed towards a simple and low-cost nonpharmacological treatment, watching animated cartoons, the impact of which on pain behavior during rehabilitation management in children with burn injuries has rarely been studied. We assumed that watching animated cartoons could distract children with burn injuries, thus reducing their behavioral responses to pain resulting from dressing changes. The point of pain assessment for children, however, includes the selection of appropriate measurement tools with easy to understand instructions. In the meantime, self-measurement is also used for pain assessment, as the feeling of pain is fairly subjective. However, children have poor physical and cognitive development [17], so the results depend largely on feasible and valid pain assessment tools [18]. According to current research, there is no universally acknowledged scale for pain intensity quantification, therefore, we adopted the Wong-Baker faces pain rating scale, COMFORT scale, FLACC scale and POCIS simultaneously.

Methods

Issues raised and feasibility

Dressing changes are often accompanied by severe and unbearable pain for children with burn injuries, which seriously influences the

therapeutic efficacy and rehabilitation management. Worse still, standard analgesics exhibit poor abirritation with some side effects for children aged from 3 to 7, thus uncovering the necessity of nonpharmacological pain management. Watching animated cartoons as a non-pharmacological analgesic for children with burn injuries through distraction shows the potential for solving those problems created by traditional analgesics. Therefore, it is worthwhile to investigate relevant issues and conduct this research.

Participants

Participants were recruited from the Burn and Plastic Surgery unit of Third Xiangya Hospital under the following inclusion criteria: a. age limits ranging from 3 to 7, b. TBSA greater than 1%, c. parents described the specific animated cartoons that the children enjoyed and these preferences were confirmed by previous investigation, d. at least 10 dressing changes were expected. The exclusion criteria were as follows: a. exposed facial burn injuries, b. severe intellectual disability symptoms, c. depression or other psychological diseases, d. cardiac insufficiency, renal dysfunction, hemophilia or other hemorrhagic disorders. Participants were enrolled from April 2015 to April 2017. Of the 79 children with burn injuries who met the inclusion criteria, 54 agreed to participate in the trial with informed consent provided by their family members, whereas the other 25 refused. Characteristics of the participants are shown (Table 1).

Quality control

Three physicians in the Burn and Plastic Surgery unit of Third Xiangya Hospital served as assessors during the pain intensity quantification process with 4 scales. The chief physician in the same department, the person in charge of the assessment, was mainly responsible for the following: a. gaining a full grasp of detailed scoring rules for the 4 scales, b. training assessors, and c. reviewing and summarizing the raw data. In the course of training, the assessors were gathered and uniformly trained to achieve a consistent understanding of the scoring standards. The training was followed by an independent assessment of the same child whom the physicians observed together. After that, the assessors raised issues they encountered and

Application of animated cartoons in children with burn injuries

reached a consensus through discussion of these issues. The physicians then observed one child separately and made appropriate independent pain assessments. The procedure was repeated until similar results were given by 3 different individuals.

Ethical review

The research protocol was approved by the Third Xiangya Hospital ethical review board. After being informed of the aim and methods of our research, guardians of the pediatric participants gave their written consent and permission. The dressing changes were videotaped with parental consent under the condition that the surgical procedure was not interrupted.

Intervention

Children in the control group were only treated with standard analgesic (ibuprofen, with a minimum dose of approximately 5-10 mg/kg), whereas those who in the intervention group watched animated cartoons in addition at the same time. A self-control method was adopted (i.e., all children were treated as the control group at the outset with animated cartoon intervention being applied to the following treatment). The trial launched one day after the children who participated in the project were found with burn injuries. One hour following standard analgesic administration, dressings were changed every day under the same circumstances between 8:30 and 11:30. Full recordings of ten procedures were preserved with the consent of the children and their guardians. When we applied intervention measures, the children were able to choose their favorite animated cartoon from multiple options, and the same plot was not to be repeated. Children chose to watch the cartoons on a television or smartphone. The cartoons were played when the children entered the treatment room, but we did not start to remove the wound dressing until they concentrated on the cartoon plot with smiles and laughter. Afterward, encouragement and acknowledgments were presented to the children. To be specific, the three stages of the dressing change treatment were as follows: 1) removal of the waste dressing, 2) surgical wound debriding, and 3) applying the new dressing. That treatment measure was repeated 10 times, and which participants began

to act as control-group members, alternating to the intervention group in the next dressing change, and repeating the cycle from control-group management to intervention-group management in turn (ABABAB pattern) in the residual 8 treatments. Thus, participants watched animated cartoons every other day. Dressing changes for all children were done in the same therapeutic room at the same time every day.

Pain behavior assessment

Pain behavior was assessed by observers using the Wong-Baker faces pain rating scale, COMFORT scale, FLACC scale and POCIS. Specifically, in the COMFORT scale, a helpful tool that has been widely used abroad for pain behavior assessment in children, there are 6 categories including Alertness, Calmness/agitation, Crying, Physical movement, Muscle tone and Facial tension. With a full mark of 30, each category is scored on a 1 to 5 scale. In practice, suggestive information is offered according to the sum of the scores among the 6 categories. The higher scores one obtains, the more violent the pain ([Table S1](#)). Necessary pain interventional therapies shall be taken if the scores add up to more than 17. Similarly, the FLACC scale consists of 5 categories, Face, Legs, Activity, Cry and Consolability, each of which accounts for scores of 0 to 2. With 10 as the full mark, 0 to 3, 4 to 7 and 8 to 10 scores represent no/light pain, moderate pain and acute pain, respectively ([Table S2](#)). POCIS was used for pain behavioral assessment with points ranging from 0 to 7, in which 0, 1 to 2, 3 to 4 and 5 to 7 are recorded as no pain, slight pain, moderate pain and severe pain, respectively, with 7 categories each contributing 0 or 1 point towards the overall score ([Table S3](#)). The Wong-Baker faces pain rating scale includes 6 pain assessment cards that vary from a smile to sad to crying facial expressions representing pain behavior rating and is supervised by the Chinese Association for the Study of Pain (CASP). The patient chooses the best card to represent the pain intensity ([Figure S1](#)).

Statistical analysis

After collecting results from 54 children, Levene's test was used for equality of variance. The comparison of differences between the control and intervention group was performed by independent t-test using SPSS 19.0 Software

Application of animated cartoons in children with burn injuries

Table 2. Comparison of the scores of the FLACC scale (A), Pain Observation Scale (B), Wong-Baker FACES Pain Rating Scale (C) and COMFORT Behavior Scale (D) between the intervention group and control group

A. Comparison of the scores of the FLACC scale between the intervention group and control group			
	Before dressing change	During dressing change	After dressing change
Intervention group	5.651±0.547	5.675±1.091	5.059±0.403
Control group	5.812±0.445	5.823±1.095	5.073±0.501
<i>T</i>	0.986	0.661	0.002
<i>P</i>	0.322	0.544	0.980
B. Comparison of Pain Observation Scale scores between the intervention group and control group			
	Before dressing change	During dressing change	After dressing change
Intervention group	6.109±1.140	6.247±1.095	5.050±0.707
Control group	6.230±1.304	6.298±0.707	5.203±0.836
<i>T</i>	0.903	0.834	0.986
<i>P</i>	0.372	0.405	0.322
C. Comparison of Wong-Baker FACES Pain Rating Scale scores between the intervention group and control group			
	Before dressing change	During dressing change	After dressing change
Intervention group	7.212±0.837	7.854±1.091	6.026±0.501
Control group	7.339±0.707	7.867±1.095	7.231±0.403
<i>t</i>	0.953	0.005	2.901
<i>P</i>	0.347	0.930	0.008*
D. Comparison of COMFORT Behavior Scale scores between the intervention group and control group			
	Before dressing change	During dressing change	After dressing change
Intervention group	23.803±3.701	22.456±3.435	19.044±1.204
Control group	24.848±2.588	24.429±3.535	21.602±1.316
<i>t</i>	1.203	1.778	2.679
<i>P</i>	0.231	0.085	0.011*

Note: *indicating statistical significance. A. Compared to the control group, data assessed by FLACC scale in the intervention group had no significant differences ($P>0.05$); B. Compared to the control group, data assessed by POCIS scale in the intervention group had no significant differences ($P>0.05$); C. The rating scores of Wong-Baker faces pain rating scale 5 min before and during dressing changes ($P>0.05$). However, scores on the basis of Wong-Baker faces pain rating scale were different with statistical significance between control (7.231±0.403) and intervention group (6.026±0.501) ($P<0.05$) at 5 min after the treatment procedure. D. The rating scores of COMFORT scale 5 min before and during dressing changes ($P>0.05$). However, scores on the basis of COMFORT scale were different with statistical significance between control (21.602±1.316) and intervention group (19.044±1.204) ($P<0.05$) at 5 min after the treatment procedure.

regarding data from the Wong-Baker faces pain rating scale, COMFORT scale, FLACC scale and Pain Observation Scale for Young Children (POCIS). The error bars in the figures represent SD or SEM. The data were considered significant when $P<0.05$.

Results

Pain assessment outcomes among different scales

We ensured that the variances of the test group and the control group did not differ significantly. Compared with the control group, data assessed by FLACC scale and POCIS in the intervention group were not significantly different ($P>0.05$); the rating scores of Wong-

Baker faces pain rating scale and COMFORT scale 5 min before and during dressing changes were also not different ($P>0.05$). However, what was fairly noteworthy was that 5 min after the treatment procedure, scores on the Wong-Baker faces pain rating scale were different with a statistical significance between the control (7.231±0.403) and intervention groups (6.026±0.501) ($P<0.05$). Similarly, when referring to the COMFORT scale, the scores from the control group and intervention group were significantly different ($P<0.05$) (Table 2).

Statistically analyzed outcomes

After analyzing raw statistics and constructing graphics, it was evident that 5 min after replacing wound dressings with standard analgesic,

Application of animated cartoons in children with burn injuries

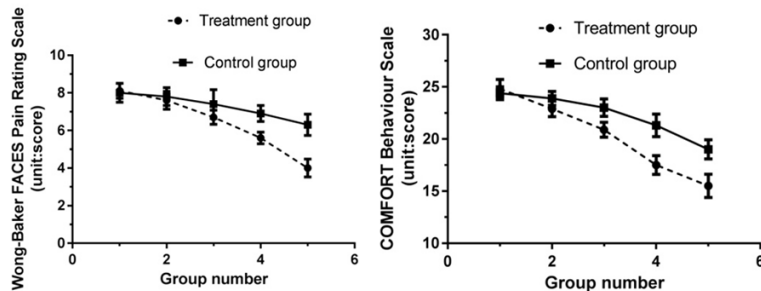


Figure 1. The downward trend of the treatment and control groups. The trend that mean scores in the of intervention group judging by Wong-Baker faces pain rating scale declined more dramatically than in the control group with an independent t-test ($P < 0.05$); the COMFORT scale comparison resulted in the coming to the same findings.

the assessment scores with the Wong-Baker faces pain rating scale (mean score: control group = 7.231, intervention group = 6.026) and COMFORT scale (mean score: control group = 21.602, intervention group = 19.044) were markedly lower when animated cartoons were administered ($P < 0.05$). Our data confirmed the trend that mean scores in the intervention group judging by Wong-Baker faces pain rating scale declined more dramatically than in the control group with an independent t-test ($P < 0.05$); the COMFORT scale comparison resulted in the same findings (**Figure 1**).

The differences between subsequent results appeared increasingly absolute from the first treatment procedure forward.

Scores of each separate category included in the COMFORT scale between the control and intervention group were further analyzed in each separate treatment (**Figure 2**). The grading scores of the intervention group experienced a sharper downward trend than the control group ($P < 0.05$) with respect to Alertness, Calmness/agitation, Crying, Physical movement and Facial tension. Nevertheless, there was no difference between the groups in the Muscle tone category ($P > 0.05$).

Discussion

Pain has become almost commonplace in burn patients, and it is widely regarded as the fifth essential vital sign, apart from temperature, respiration, blood pressure, and heart rate [19]. Pain is defined as an unpleasant sensory and emotional experience in relation to existent or potential tissue damage [20]. As a result, it is

fairly subjective. The feelings and responses to pain vary among individuals. There are some differences between pain and other vital signs that can be quantified and assessed accurately. The primary pain measurement method remains self-assessment [21], which is regarded as a reference when using the results of other assessment tools to describe pain intensity. In our research, however, we adopted 4 pain measurement scales simultaneously,

owing to the poor self-assessment capability among children with burn injuries aged 3-7 years [22].

According to the statistical outcomes of **Table 2A** and **2D**, the Wong-Baker faces pain rating scale and COMFORT scale revealed obvious pain behavior changes when we applied animated cartoons as extra nonpharmacological pain treatment. However, the FLACC scale and POCIS showed inconspicuous assessment consequences in distinguishing severe pain degrees resulting from wound dressing change procedure, due to the limited options and score value in each category.

In contrast to the slope-change trend of the mean scores related to separate categories in the control group, scores in the intervention group dropped more sharply (**Figure 1**), demonstrating that watching animated cartoons may well distract children burn victims and efficiently alleviate pain disorders in the process of dressing changes, eliminating their concentrations on the pain stimulation. The validity of attention distraction was rooted in the fact that recognition was regarded as the determinants of pain and the ability to focus on specific stimulation is limited [23]. For those reasons, children patients suffer from less pain by means of concentrating on alternative external stimulations.

The feasibility and therapeutic effectiveness of watching animated cartoons were supported by the comparison between mean scores of each category in the COMFORT scale. Animated cartoon watching obviously alleviated the pain of children with burns in the aspect of alert-

Application of animated cartoons in children with burn injuries

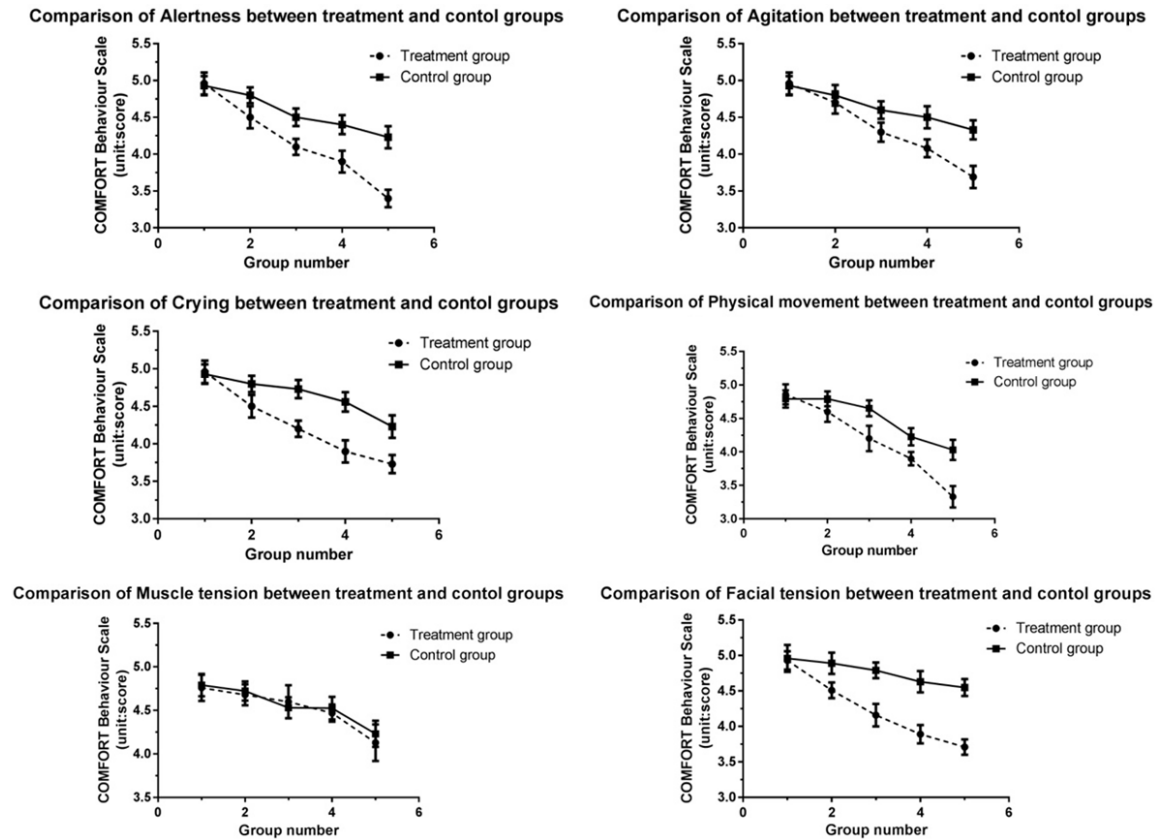


Figure 2. Comparison of scores of each separate category included in the COMFORT behavior scale between treatment and control groups. The grading scores of the intervention group experienced a sharper more sharply downward trend than the control group ($P < 0.05$) within respect to of Alertness, Calmness/agitation, Crying, Physical movement and Facial tension. Nevertheless, there was no difference between the groups in the when speaking of the Muscle tone category, that finding turned to remain not that evident ($P > 0.05$).

ness decrease, calmness state, crying, physical movement and facial tension 5 min after the dressing change treatment. Pain behavior corresponding to those aspects was significantly relieved after the therapeutic procedure. Meanwhile, although the data and relevant results during the treatment procedure did not reach significance differences, it truly exhibited positive effects on the pain management of burn pediatric patients, as the anxiety level of participants exhibited a marked downward trend and children became better-adapted to the dressing changes. The majority of children with burn injuries were in favor of watching cartoons during the dressing change treatment. On the other hand, the participants were usually observed to cry in pain without cartoons, thus reducing their willingness to receive treatment.

Ibuprofen is the only pediatric NSAID recommended by both the World Health Organization

(WHO) and the Food and Drug Administration (FDA) and is considered as the preferred non-steroidal anti-inflammatory drug (NSAID) for children [24]. With rapid oral absorption and remarkable efficacy, ibuprofen is broadly used in order to relieve pain symptoms in skin, joints, skeletal muscle, nerves, etc. [25]. A short plasma half-life of elimination ($t_{1/2} = 1.8-2$ h) and other pharmacokinetic properties of ibuprofen indicate that most drugs are eliminated within 24 h [26], which certifies that pharmacodynamic actions provided the previous day had little influence on the next-day research. Diverse plots were introduced in the case that animated cartoon distractions existed before may leave effects on outcomes of the latter trial.

The primary propose of this research was to evaluate the therapeutic effects of watching animated cartoons, a practical and low-cost intervention method. This study demonstrated that animated cartoon distraction is not that

effective for relieving pain in children with burn injuries during dressing changes. Above all, in contrast to other pediatric patients, children with burn injuries are supposed to be more difficult to distract because their therapies are not initiated from a pain-free baseline. Small, C. et al. reported that dressing change was the most painful experience in burn rehabilitation [27]. Perhaps the attention of children with burn injuries was not sufficiently interrupted by watching animated cartoons, a passively performed distraction method, thus contributing to the failure to totally ignore the pain stimulation. Parry, I. et al. examined video games, virtual reality games and other interactive distraction tools and described that those tools were likely to be more effective for pain intervention. Furthermore, even the minor operation of dressing changes requires a longer time than other treatments and is also more intense. Owing to the small sample size and uneven distributions of participant age, burn area and depth, this study only provided some rough results. Our research, in addition, was conducted in the wound healing stage rather than the initial debridement stage. Therefore, the interpretation of these results leads to inaccuracy to some extent, which should be viewed in a critical way. The sample size is suggested to be expanded with child burn victims sharing close and uniform burn area and depth to be conducted in multicenter and extensive clinical trials without breaking the law.

Disclosure of conflict of interest

None.

Abbreviations

VR, Virtual reality; POCIS, Pain Observation Scale for Young Children; TBSA, burned total body surface area.

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Application of animated cartoons in children with burn injuries

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Application of animated cartoons in children with burn injuries

Table S1. COMFORT Scale

Scoring Categories	1	2	3	4	5
Alertness	Deeply asleep	Lightly asleep	Drowsy	Full awake alert	Hyperalert
Calmness/agitation	Calm	Slightly anxious	Anxious	Very anxious	Panicky
Crying	No crying	Slightly crying	Whimper	Obviously crying	Yelping
Physical movement	No movement	Occasional, slight movement	Frequent, slight movement	Vigorous movement limited to extremities	Vigorous movements including torso and head
Muscle tone	Muscles totally relaxed	Reduced muscle tone	Normal muscle tone	Increased muscle tone and flexion of fingers and toes	Extreme muscle rigidity and flexion of fingers and toes
Facial tension	Facial muscle totally relaxed	Facial muscle tone normal; no facial muscle tension evident	Tension evident in some facial muscles	Tension evident throughout facial muscles	Facial muscles contorted and grimacing

Table S2. FLACC Scale

Scoring Categories	0	1	2
Face	No particular expression or smile; disinterested	Occasional grimace or frown, withdrawn	Frequent to constant frown, clenched jaw, quivering chin
Legs	No position or relaxed	Uneasy, restless, tense	Kicking or legs drawn up
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid, or jerking
Cry	No crying (awake or asleep)	Moans or whimpers, occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching, hugging, or talking to. Distractable	Difficult to console or comfort
Facial tension	Facial muscle totally relaxed	Facial muscle tone normal; no facial muscle tension evident	Tension evident in some facial muscles

Application of animated cartoons in children with burn injuries

Table S3. POCIS Scale

Categories	Scoring	
	0	1
Face	Relaxed	Pain/frown
Crying	No	Moans/crying/screams
Respiration	Relaxed, frequent	Panting
Torso	Relaxed	Restlessness, jitter
Epipodite	Relaxed/No obvious abnormality	Restlessness, Arm swing, Clenched fist
Lower limb	Relaxed/No obvious abnormality	Restlessness, Kicking
Awake	Sleep, play, sedative	Dysphoria, annoyance

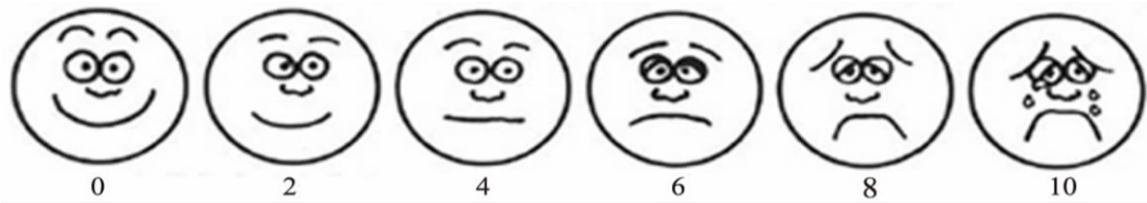


Figure S1. Wong-Baker faces pain rating Scale.