

► <https://doi.org/10.19048/2411-8729-2020-6-2-31-34>



# CURRENT SITUATION OF CHILD ABUSE IN JAPAN AND EFFORTS TO OBTAIN OBJECTIVE EVIDENCE OF BRUISING FROM CHILD ABUSE

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**Abstract.** Child abuse in Japan has become a social problem, with yearly increases in the number of consultations at child consultation centers. Of the four classifications of child abuse (physical abuse, neglect, sexual abuse, and emotional abuse), Japan has seen a particular increase in emotional abuse. Capturing evidence of child abuse is difficult. Generally, photographs are used as evidence, but the photography requires instructions. Three studies are introduced with alternate methods to enable bruising to be used as evidence of child abuse. First, spectrophotometry is used to digitize the color of skin, and provide scientific evidence of the co-existence of old and fresh bruises. Second, the diagnostic equipment of ultrasonography is used to evaluate the depth and thickness of subcutaneous hemorrhages that are due to bruising and which decrease over time after the bruising had occurred. Ultrasonic diagnosis can evaluate both the depth and thickness of such subcutaneous hemorrhages and illustrate the healing process. Third, forensic light source was used, which effectively uses violet light to enhance the visibility of bruises over time, even after old bruises become yellowish and can be hard to differentiate with the naked eye. These methods are useful for visualizing bruises and for capturing the evidence of child abuse. The methods are currently under study, but application in a clinical setting is expected.

**Keywords:** child abuse, child consultation centers, bruise, spectrophotometry, ultrasonography, forensic light source

**For citation:** Mimasaka S. Current Situation of Child Abuse in Japan and Efforts to Obtain Objective Evidence of Bruising from Child Abuse. *Russian Journal of Forensic Medicine*. 2020;6(2):31–34. <https://doi.org/10.19048/2411-8729-2020-6-2-31-34>

Submitted 27.01.2019

Revised 17.03.2020

Published 28.06.2020

# ПРОБЛЕМА ЖЕСТОКОГО ОБРАЩЕНИЯ С ДЕТЬМИ В ЯПОНИИ И СПОСОБЫ ДОКАЗАТЕЛЬНОГО УСТАНОВЛЕНИЯ ФАКТА ПОБОЕВ У РЕБЕНКА

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**Аннотация.** В современной Японии жестокое обращение с детьми является социальной проблемой, что находит отражение в ежегодном увеличении числа обращений в детские консультационные центры. Из четырех форм жестокого обращения с детьми (отсутствие заботы, физическое, сексуальное и эмоциональное насилие) именно эмоциональное насилие получило распространение в стране. Доказательное установление насилия над детьми является непростой задачей. Обычная практика фотодокументирования предполагает инструктаж. В статье описываются три методики, основанные на альтернативных подходах к документированию побоев как доказательству жестокого обращения с ребенком. Так, спектрофотометрия позволяет исследовать оцифрованные цветные снимки кожных покровов с получением доказательных свидетельств единовременного наличия старых и свежих кровоподтеков. Вторая методика использует ультразвуковое оборудование для оценки глубины и плотности подкожных кровоизлияний, полученных в результате побоев и уменьшающихся со временем. Ультразвуковая диагностика позволяет оценить оба этих параметра и описать процесс восстановления. Третья методика использует криминалистические фонари с источником УФ-излучения для улучшения визуализации выцветающих кровоподтеков, в том числе приобретающих трудноразличимый невооруженным глазом желтоватый оттенок. Эти методики подходят для целей визуализации кровоподтеков и документирования доказательств жестокого обращения с детьми. Методики апробируются с перспективой их применения в клинической практике.

**Ключевые слова:** жестокое обращение с детьми, детские консультационные центры, кровоподтек, спектрофотометрия, ультразвукография, криминалистические фонари

**Для цитирования:** Мимасака С. Проблема жестокого обращения с детьми в Японии и способы доказательного установления факта побоев у ребенка. *Судебная медицина*. 2020;6(2):31–34. <https://doi.org/10.19048/2411-8729-2020-6-2-31-34>

Поступила 27.01.2019

Принята после доработки 17.03.2020

Опубликована 28.06.2020

#### ◇ I. CURRENT SITUATION OF CHILD ABUSE IN JAPAN

There are 212 child consultation centers in Japan, where 159,850 consultations for child abuse cases have been provided between April 2018 and March 2019 [1]. A continuous annual increase in the number of consultations at these centers have observed; the number was 6,932 in 1998, which has increased by approximately 23 times in the last 20 years. The number of consultations particularly increased at a rapid rate in 2000 (the year in which the law on child abuse was enacted), and saw a similar increase in the years 2003 and 2010, following the report of a horrible case of child abuse.

In Japanese Act on the Prevention of Child Abuse classifies child abuse into four types: physical abuse, neglect, sexual abuse, and emotional abuse [2]. **Physical abuse** is defined in general terms as “any non-accidental physical injury to the child,” and includes striking, kicking, burning, or biting the child, or any action leading to physical impairment. **Neglect** is defined as the failure of a parent or any other person with responsibility for the child to provide necessary food, clothing, shelter, medical care, or supervision to the degree that the child's health, safety, and well-being are not threatened with harm. **Sexual abuse** occurs when a child is raped or forced to commit a sexual act and includes touching a child's genitals or making a child touch someone else's genitals, making a child pose or perform for pornographic pictures or videos, showing pornographic materials to a child, and so on. **Emotional or psychological abuse** is defined as a pattern of behavior that has negative effects on a child's emotional development and sense of self-worth, and includes ignoring a child or withholding love, support, or guidance.

The number of consultations for emotional abuse in particular has remarkably increased in Japan in the recent years. One form of emotional abuse is domestic violence, which is inflicted on a spouse in a home wherein children live. Since 2015, when the 3-digit phone number (189) to reach the child consultation centers was made available for the first time, there has been an increase in awareness regarding child abuse, with a subsequent increase in the number of relevant consultations. This has led to increase in the workload of the staff at these consultation centers.

#### ◇ II. PHOTOGRAPHY OF THE EVIDENCE OF ABUSE

When child consultation centers receive notice of a child abuse case, they ensure the security of the child by temporarily protecting the child if abuse is suspected. Generally, however, it is difficult to obtain evidence of child abuse. In medical certificate of injury, though a written description of physical findings remains an important aspect of child abuse injury documentation, photography is a common method used to provide evidence of child abuse [3]. Yet, staff who are unfamiliar with the nuances of photography usually do not achieve a sufficient level of camera focus and brightness when taking photographs. Therefore, multiple scans become necessary and include more than two views of photography, including a wide area view and a macrophotograph of the injury. It is also recommended that staff place a scale near the injury in a macrophotograph and, because young children do not remain still for photographs, staff also need to time the photograph so that it is taken in moments when the child remains still, usually achieved by giving the child a toy. The child consultation centers sometime request for forensic pathologists, who provide a medical certificate of injury as evidence for the wounds, in case the child has a wound, for the purpose of examination. Forensic pathologists routinely record injury findings, and are experts at speculating the weapon that was used. Moreover, forensic pathologists are required for created a legal document for the case.

#### ◇ III. ATTEMPT TO PROVE A BRUISE OBJECTIVELY

This chapter describes several objective methods of examining bruises in victims of physical child abuse.

##### 1. Spectrophotometry

Bruises are found in 90 % of physical child abuse cases [4]. The co-existence of old and fresh bruises is strong evidence for the diagnosis of chronic abuse; however, estimating the age of bruises is often difficult. However, generally, the color of a bruise changes over time; we intend to digitize skin discoloration changes in order to estimate the age of bruising.

Spectrophotometry was used to estimate the age of a bruise by evaluating the color [5]. We examined the tristimulus values of the colors of bruises while using the healthy skin area as control. We measured until an induced bruise had healed in healthy volunteers. A color can be expressed by the tristimulus method;  $L^*$ ,  $a^*$  and  $b^*$ .  $L^*$  means lightness from black to white;  $a^*$  means color directions from green to red; And  $b^*$  means color directions from blue to yellow. The differences in the tristimulus values;  $\Delta L^*$ ,  $\Delta a^*$ , and  $\Delta b^*$ , between the bruised area and the control area of healthy skin were calculated.

Figure I shows the patterns in color changes expressed by the tristimulus method.  $\Delta L^*$  increased with time, and cleared at 0.  $\Delta a^*$  decreased with time, and cleared at 0.  $\Delta b^*$  was low at the beginning, but gradually increased and decreased as it got closer to 0. The age of bruises can be classified objectively into four phases by digitizing the color changes. Therefore, the digitization methods used in this study should be useful in assessing the age of bruises and helpful in diagnosing child abuse and neglect.

It should be noted, however, that recent reviews emphasize the difficulties in aging bruises. The time taken for a bruise to develop depends on the depth of injury; deeper bruises take longer to appear. The color of the bruise also depends on depth. In superficial bruises, a yellowish tinge appears within 3 days, whereas in deeper bruises, the yellow color may only appear within 7–10 days. Studies have confirmed that yellow bruises are older than 18 hours [6] and that other colors including red, blue, purple, or black can occur in bruises from any time from 1 hour to resolution [4]. The spectrophotometric method therefore has some limitations. Wounds that occur at the same site in children of similar age may take different amounts of times to heal. This puts a limit to the use of this method, which relies on the observation of skin color changes. It should be observed that subcutaneous hemorrhage occurs with a bruise.

##### 2. Ultrasonography

Using ultrasonography [7], a previous study precisely evaluated both the depth of the subcutaneous hemorrhage from the skin surface, and the thickness of the subcutaneous hemorrhage from a bruise. Using ultrasonography, in this study, subcutaneous hemorrhage in forensic autopsy cases was observed as a hyperechoic area. A significant correlation was observed between the thickness of the subcutaneous hemorrhage in the macroscopic examinations and the ultrasonographic images.

Using ultrasonography, in the next stage, we observed the subcutaneous bleeding of bruises in healthy child volunteers. We examined the relative changes in the depth from the skin surface to the subcutaneous hemorrhage from a bruise over time. We found that the depth did not change over time. In contrast, using ultrasonography, we observed relative change in the thickness of the subcutaneous hemorrhage over time after the bruise had developed. The thickness of the bleeding decreased per day.

Ultrasonographic images could capture the thickness of the subcutaneous hemorrhage from a bruise as it decreased over

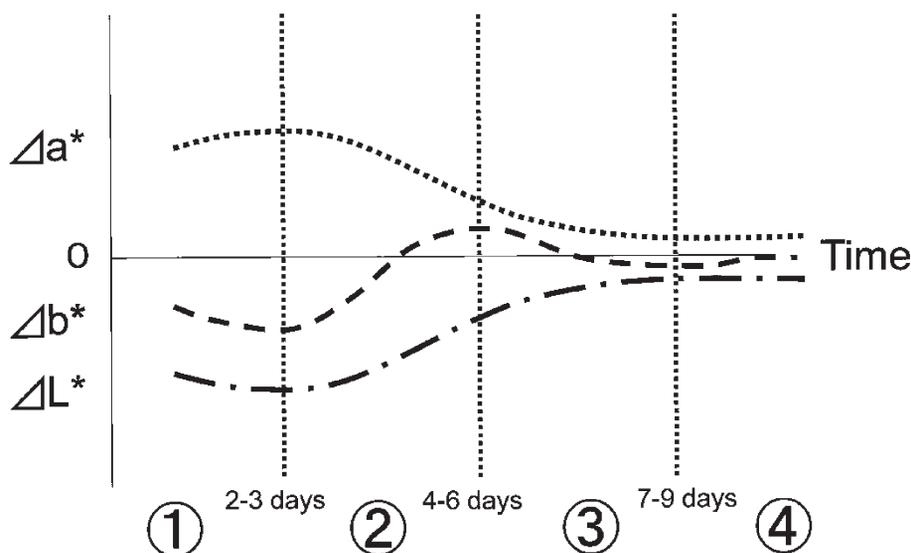


Fig. 1. Patterns of color changes expressed by the tristimulus method

Рис. 1. Структура изменения цвета в единицах метода трехцветного сигнала

time. In this study, we found that it is possible to accurately measure the depth from the skin surface to the subcutaneous hemorrhage, and the thickness of the subcutaneous hemorrhage, using ultrasonography.

### 3. The visualization of an old bruise

Bruises in children heal quickly. It is difficult to confirm an old bruise because once it heals, it leaves no evidence to photograph. Some researchers report using ultraviolet (UV) radiation to irradiate an old bruise and then visualize it [8–14]. However, UV rays have harmful effects. There should be hesitation in using harmful UV radiation on healthy children, even if the purpose is to ensure protection from abuse. Therefore, the investigation of the optimal wavelength to visualize old bruises in children was initiated [15]. In this study, four forensic light sources (UV, violet, blue, and blue ring light) were compared. The results indicate that the time interval for which the bruise could be observed under violet light was significantly longer compared to other types of light. Although the bruise could not be observed under the visible ray because it has healed, we could observe the bruise under the special light wavelength. The observation under violet light was possible for a longer time and was clear. The bruise presented as xanthochromia during the healing process, and the observation of the old bruise under the visible ray was limited. We believe that this was caused by the fact that yellow and purple are combinations of complementary colors. This study showed that short wavelength lights were not superior in the visualization of old bruises. Violet light has a longer wavelength than ultraviolet rays and could visualize old bruises clearly. Violet light is also less harmful than ultraviolet rays.

## IV. CONCLUSION

It is important to retain objective evidence of abuse in order to protect abused children. Injuries in children heal quickly, therefore they must be examined early and the evidence of the abuse must be obtained. We also suggest that considerable effort should be channeled toward performing minimally invasive antemortem examinations in children. Pain, fear, and excessive suppression are not suitable for the proper examination of children.

Of course, the examiner should ask a parent and a child how the bruise occurred, however, children may not tell

the truth in front of their parent. Therefore, it is necessary for the examiner to ask a parent and a child separately. The contradiction of the explanation by a parent or the child coupled with the objective evidence may lead to a diagnosis of the cause of the abuse.

I forward these studies for visualizing bruises and for capturing the evidence of child abuse. These methods are still in the research stage, but will be available for practical application in the future.

**Acknowledgements:** I would like to thank Editage (www.editage.com) for English language editing.

**Благодарности:** Автор благодарен компании Editage (www.editage.com) за редактирование рукописи на английском языке.

**Conflict of interest:** the author declares no apparent or potential conflicts of interest.

**Конфликт интересов:** конфликт интересов отсутствует.

**Funding:** This research was supported by JSPS KAKENHI Grant Numbers JP19790447, JP21790603, JP23390182 and JP16K01857.

**Финансирование:** Работа выполнена при поддержке Японского общества содействия науке (JSPS KAKENHI, гранты №№ JP19790447, JP21790603, JP23390182, JP16K01857).

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► **Contributions.** Authors are solely responsible for submitting the final manuscript to print. All authors participated in the development of the concept of the article and the writing of the manuscript. The final version of the manuscript was approved by all authors. The authors are grateful to anonymous reviewers for helpful comments.

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