# Classic Metaphyseal Lesions among Victims of Abuse

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**Objective** To use legal statements by perpetrators to gain new insights into the causative mechanism of classic metaphyseal lesion (CML). The CML, so called "corner fracture," is considered a highly specific marker for abuse in infants. However, the precise correlation between CMLs and abusive head trauma is still unknown.

**Study design** In this retrospective observational study, we selected 67 cases with at least 1 CML from a 15-year cohort of legally prosecuted child abuse cases. Their clinical, radiologic, and forensic records were analyzed. In 27 cases, the perpetrator confessed to abusing the child and described the events. Potential associations with subdural hematoma and with confession were evaluated using 2 separate binary logistic regression models.

**Results** All 67 infants showed other signs of abuse. Median age was 3.4 months. Over 65% had multiple CMLs. Knees and ankles were predominantly involved (64%). Only CMLs of the shoulder were significantly associated with subdural hematoma ($P$ = .03). Different-age fractures were more common in the nonsubdural hematoma group ($P$ = .01). In the group with confessions, perpetrators admitted inflicting violent indirect skeletal forces (torsion, traction, compression, and forced movements). The most common circumstance was diapering (44%), reported by male perpetrators only ($P$ = .03) followed by dressing/undressing (30%). The violence was habitual in 67% of cases.

**Conclusions** This unique forensic case series shows that CMLs are caused by violent acts inflicted most during physical care of infants. The frequency of habitual violence responsible for CMLs deserves greater attention. *(J Pediatr 2019;209:154-9)*.

Skeletal fractures have long been reported in the context of child abuse, and the classic metaphyseal lesion (CML) is considered a highly specific marker for abuse in infants.[1-5] CMLs are diagnosed using plain radiographs and are more commonly known as "corner" or "bucket-handle" fractures, depending on the radiographic projection.[6] The CML is a fracture through immature metaphyseal bone near the growth plate and is thought to be caused by torsion or traction on the joint.[5-7] It is not yet clear if CMLs are related or not to abusive head trauma.[8-11] Comparison of perpetrators' legal statements with the full medical records of their victims is a novel approach to better understand this type of fracture.

## Methods

This was a descriptive retrospective case study conducted over a 16-year period (January 2002-December 2017); it is an extension of a previous study[12] focusing on abusive head trauma.

### Population

From >500 cases of diagnosed abuse referred to the authors as experts by 92 courts throughout France, the medical and legal records of all patients with at least 1 CML (**Figure**; available at www.jpeds.com) were selected. In France, medical experts are by law independent of all of the parties in the legal system.[13]

The initial abuse diagnosis was made at the hospital by the pediatrician who reported the cases. The diagnosis of abuse, based on both the pattern of the CMLs and the presence of other signs of abuse (as a previous history of traumatic injury, concurrently identified injury, subdural hematoma [SDH], etc) was then confirmed in 100% of cases by the authors who had access to all of the medical and legal records.

### Collected Data and Definitions

The clinical data (including the health record from birth), laboratory data, and skeletal surveys were reviewed by a forensic pediatrician and a pediatric radiologist each with more than 30 years of experience. All living children were examined by the pediatrician author. In accordance with current imaging guidelines for cases of suspected child abuse, each child had a full

| | |
|---|---|
| CML | Classic metaphyseal lesion |
| SDH | Subdural hematoma |

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skeletal survey and an interpretable head computed tomography or magnetic resonance imaging.[14,15]

All markers for abuse were exhaustively noted, in particular CML and non-CML fractures, concurrently identified injuries, previous traumatic injuries, retinal hemorrhages, and SDHs.

As forensic medical experts, the authors analyzed all of the written evidence from the police investigations and court hearings. They judged a confession to exist when the perpetrator admitted a direct causal link between the violence and the child's fracture(s), and described the circumstances and mechanisms of the fracture(s) clearly and consistently over time. The authors analyzed the circumstances and mechanisms of the violence responsible for the fractures and whether it was recurrent, and selected key words used frequently by the perpetrators. When confessions were available for head trauma, they were also analyzed.

The characteristics of the patients and their injuries were described using the median (and range) for continuous variables and the frequency (and percentage) for categorical variables. Patient age was calculated from the date of birth—or corrected age, if born prematurely—to age at the time of CML diagnosis.

### Statistical Analyses

Potential associations with SDH and with a confession were evaluated with 2 separate binary logistic regression models. Both univariate and multivariate logistic regression were used. A criterion of $P < .20$ in the univariate analysis was used to select variables for inclusion in the multivariate model. Results were expressed as an OR and its 95% CI. The adequacy of the model was assessed using the Hosmer-Lemeshow test. In addition, the Fisher exact test was used to analyze potential associations between perpetrator sex and the various circumstances of abuse (diapering, dressing, feeding, etc). All statistical analyses were performed using SAS v 9.4 software. (SAS Institute, Cary, North Carolina).

No ethics committee approval was needed, as the data were anonymized and came from a database of forensic experts' findings.

## Results

Overall, 67 forensics files from 33 courts throughout France were included in the study.

### Population Characteristics

All 67 infants showed other signs of abuse (in addition to the CML): previous history of traumatic injury, concurrently identified injury, SDH, or different-age fractures (Table I).

There was no sex predominance among the victims. The median age was 3.4 months (0.4-16.1). Only 1 child was older than 1 year. Eight of the children (12%, n = 67) (5 girls, 3 boys) were born prematurely (<37 weeks last menstrual period). None of the children were born before 33 weeks after the last menstrual period.

**Table I. Characteristics of the study population**

| Characteristics | Total population N = 67 |
|---|---|
| Age in mo, median (range) | 3.4 (0.4-16.1) |
| Sex, n (%) | |
| Female | 34 (51%) |
| Male | 33 (49%) |
| Status, n (%) | |
| Alive | 57 (85%) |
| Deceased | 10 (15%) |
| Skull fracture, n (%) | 10 (15%) |
| Chest fracture: rib, clavicle, or scapula, n (%) | 31 (46%) |
| Vertebral fracture, n (%) | 3 (4%) |
| Different-age fractures, n (%) | 49 (73%) |
| Diaphyseal fracture, n (%) | |
| None | 35 (52%) |
| Lower extremity only | 14 (21%) |
| Upper extremity only | 10 (15%) |
| Lower and upper extremities | 8 (12%) |
| SDH, n (%) | 24 (36%) |
| Retinal hemorrhage, n (%) | 18 (27%) |
| Concurrently identified injuries, n (%) | 38 (57%) |
| Previous traumatic injury, n (%) | 24 (36%) |
| No previous or concomitant traumatic injury, n (%) | 18 (27%) |
| Reason for discovery, n (%) | |
| Local sign(s) | 24 (36%) |
| SDH workup | 22 (33%) |
| Abuse workup | 15 (22%) |
| Neurologic signs | 3 (4%) |
| Sibling workup | 2 (3%) |
| Postmortem workup | 1 (1%) |
| Confessions, n (%) | 27 (40%) |
| Number of CMLs, n (%) | |
| 1 | 23 (34%) |
| 2 | 20 (30%) |
| 3 | 8 (12%) |
| 4 | 5 (7%) |
| More than 4 | 11 (16%) |
| Number of CMLs, median (range) | 2 (1-9) |

Eleven of the children had been screened for blood calcium and phosphate, urine calcium and phosphate, alkaline phosphatase, 25-hydroxy vitamin D, parathyroid hormone, and blood and urine creatinine, all of which were normal.

In 43 patients (64%, n = 67), the CML was discovered on the routine skeletal survey done to look for other signs of abuse. In addition, there were 25 SDHs or neurologic signs, 11 unexplained shaft fractures, and 3 skin lesions (bruises or burns in unusual or concerning locations) away from the site of the CML. One case was diagnosed retrospectively (CML overlooked at the time of the initial radiographs but diagnosed after a subsequent fracture). One skeletal survey was performed post mortem. One infant was diagnosed by a skeletal survey done as a result of an abuse diagnosis in her twin.

Concurrently identified injuries included bruises in unusual/concerning locations (30), burns (4), a bite (1), an intraoral injury (1), a hymeneal injury (1), an epiglottal ulcer (1), a liver laceration (1), and a lung contusion with pneumothorax (1). The total is greater than 38 because some children had multiple injuries.

Previous traumatic injuries included bruises (18), a bite (1), intraoral lesions (4, including a palate injury, a hematoma on the floor of the mouth, a gum ulceration, and a

torn frenulum of the tongue), and fractures (7, including 3 humerus fractures, 3 rib fractures, and a skull fracture). The total is greater than 24 because some children had multiple traumatic injuries. Forty-nine children (73%, n = 67) had a pattern of different-age fractures.

### CML Characteristics

Forty-four children (66%, n = 67) had multiple CMLs. Lower extremity CMLs were far more frequent than upper extremity CMLs (Tables I and II). The majority of single CMLs (n = 23) were in a lower extremity (78%, n = 67), primarily at the knee or ankle. Local signs of injury led to the diagnosis of 36% (n = 67) of the subjects.

### Association of CMLs with SDH

CMLs of the shoulder were significantly more common in the SDH group. Different-age fractures occurred significantly more often in the non-SDH group ($P = .03$) (Table III).

### Analyses of Confessions

The "confession group" included 27 files (40%) pertaining to 28 victims (1 caretaker admitted to abusing 2 children) (Tables I and IV). All of the confessions came from legal proceedings or investigations. None of the perpetrators confessed during the victim's hospitalization. In the other 40 cases (the "no confession" group), there was either no confession or the explanation for the injury changed over time (injuries blamed on falls, accidental impacts, games, actions of another child under 5 years of age, or handling by radiographers).

All of the perpetrators were adults.

The top portion of Table IV (available at www.jpeds.com) summarizes the mechanisms and circumstances of the abuse and the perpetrators' sex. There were 19 male perpetrators, including 18 fathers and 1 stepfather. There were 8 female perpetrators, including 5 nannies (1 of whom abused 2 girls) and 3 mothers. In all cases with confessions (n = 27), the perpetrator described their actions as abusive, violent, and intentional. The confessions cited excessive stress on the joints defined as "indirect skeletal forces" with "torsion, traction, violent compression (or crushing), and forced movements (crossing the arms, folding the legs up over the abdomen, separating the thighs)."

Diapering was the circumstance in which violent handling was described most frequently (44%, n = 27) by perpetrators; in all of those cases, the perpetrator was male ($P = .003$ for sex and diapering). Both women and men admitted abuse while dressing or undressing the baby (30%, n = 27). Perpetrators also cited crying (22%, n = 27) or feeding (15%, n = 27) as a trigger. In 9 of the "confession" cases in which an SDH was present, the perpetrators also confessed violent shaking and clearly differentiated between the circumstances and mechanisms of the shaking and those of the CMLs.

The violence was recurrent in 18 cases (67%, n = 27); in those, the key words used by the perpetrators were "habitual," "daily," "all the time," or "several times a week for several weeks." In most of the cases, the violence was described as having caused crying immediately after "a cracking" sound and a loss of limb mobility from violent handling.

The bottom portion of Table IV presents excerpts from perpetrator admissions illustrating the mechanisms behind the fractures, the circumstances in which the abuse occurred, and the recurring nature of the violence.

**Table II. Frequency of CMLs in the study population by anatomic location***

| | Total population N = 67 |
|---|---|
| Location, n (%) | |
| Lower extremity only | 38 (57%) |
| Upper extremity only | 10 (15%) |
| Both upper and lower extremity | 19 (28.4%) |
| CML of the knee, n (%) | 41 (61%) |
| Unilateral | 21 (51%) |
| Bilateral | 20 (49%) |
| CML of the ankle, n (%) | 36 (54%) |
| Unilateral | 17 (47%) |
| Bilateral | 19 (53%) |
| CML of the shoulder, n (%) | 15 (22%) |
| Unilateral | 10 (67%) |
| Bilateral | 5 (33%) |
| CML of the elbow, n (%) | 14 (21%) |
| Unilateral | 12 (86%) |
| Bilateral | 2 (14%) |
| CML of the wrist, n (%) | 14 (21%) |
| Unilateral | 10 (71%) |
| Bilateral | 4 (29%) |
| CML of the metatarsal, n (%) | 4 (6%) |
| Unilateral | 2 (50%) |
| Bilateral | 2 (50%) |
| CML of the hip, n (%) | 3 (4.5%) |
| Unilateral | 1 (33%) |
| Bilateral | 2 (67%) |
| Number of CMLs, n (%) | |
| Single | 23 (34%) |
| Multiple | 44 (66%) |

*All of the CMLs involved long bones.

## Discussion

Child physical abuse is a major problem and a topic that continues to generate debate.[16] Fractures are the second most common injury in abused infants, after bruising.[17,18] Initially described by Caffey and coined "classic metaphyseal lesions" (or CMLs) by Kleinman et al, these particular fractures are highly specific to nonaccidental injury.[5,6] Histologically, the fracture is located in the metaphysis, or transition zone, at the junction between the primary and secondary spongiosa, and results in the avulsion of an osteocartilaginous fragment.[5,18-22] The radiologic pattern can be subtle, ranging from transverse radiolucency of the metaphysis near the growth plate to evidence of an avulsed fragment, thus, requiring high-detail localized views.[4,23,24]

The objective of this study was to improve our knowledge of the circumstances in which CMLs occur. When, how, and how often do CMLs occur? Are CMLs related to abusive head trauma, and if so, how?

**Table III. Association with SDH**

| | Univariate analysis | | | Multivariate analysis* | |
|---|---|---|---|---|---|
| | SDH present (n = 24) | SDH absent (n = 43) | | | |
| | n (%) | n (%) | *P* | OR [95% CI] | *P* |
| CML hip + | 2 (8.3%) | 1 (2.3%) | .29 | | |
| CML ankle + | 11 (45.8%) | 25 (58.1%) | .33 | | |
| CML knee + | 16 (66.7%) | 25 (58.1%) | .49 | | |
| CML elbow + | 4 (16.7%) | 10 (23.3%) | .52 | | |
| CML shoulder + | 9 (37.5%) | 6 (14.0%) | .03 | 4.85 [1.16-20.18] | .03 |
| CML wrist + | 8 (33.3%) | 6 (14.0%) | .06 | 2.92 [0.65-13.06] | .17 |
| CML metacarpal + | 2 (8.3%) | 2 (4.7%) | .61 | | |
| CML | | | | | |
| LE only | 11 (45.8%) | 27 (62.8%) | .38 | | |
| UE alone | 4 (16.7%) | 6 (14.0%) | | | |
| Both LE and UE | 9 (37.5%) | 10 (23.3%) | | | |
| Number of CML >1 | 15 (62.5%) | 29 (67.4%) | .68 | | |
| Rib fracture | 8 (33.3%) | 23 (43.5%) | .11 | 0.56 [0.17-1.85] | .34 |
| Vertebral fracture | 0 | 3 (7.0%) | .55 | | |
| Skull fracture | 5 (20.8%) | 5 (11.6%) | .48 | | |
| Different-age fractures | 13 (59.1%) | 36 (83.7%) | .03 | 0.17 [0.04-0.65] | .01 |
| Retinal hemorrhage† | | | | | |
| Yes | 18 (78.3%) | 0 | <.0001 | | |
| No | 5 (21.7%) | 43 (100%) | | | |

*LE*, lower extremity; *UE*, upper extremity.
*Model adjusted for the presence of CML of the shoulder, CML of the wrist, rib fracture, and different-age fractures.
†Because retinal hemorrhage is part of the same clinical entity as SDH, that variable was not used in the multivariate analysis.

We used medical and legal records to answer this question because only questioning from court hearings and police investigations are sufficiently detailed and available in writing. They can be analyzed, and the consistency of perpetrator statements over time can be assessed. The French legal system is a civil law system in which judges appoint an expert to enlighten them. Thereby, the public medical experts are by law independent of all of the parties.[13]

Although this series confirms the young age of the victims, it showed no sex predominance in the victim population, in contrast to abusive head trauma, which has a strong male predominance.[25]

Of importance is that the infants included had more than 1 traumatic injury, making the diagnosis of abuse extremely reliable, which is strength of the study. Indeed, the frequency with which CMLs are accompanied by other traumatic injuries has been reported by others[26-29] and deserves more attention because some confusing alternative (non-traumatic) hypotheses have been suggested.[30] Also, more than one-third of the 67 studied cases had previous traumatic injury. This raises the issue of missed diagnosis opportunity, which has been already outlined in the literature.[31]

This series confirms some earlier findings. CMLs are usually clinically silent, which is further justification for a full, high-detail skeletal survey whenever abuse is suspected.[4,5,15,24] In addition, CMLs are often multiple and have a strong predilection for the knees and ankles.[5,19,29]

What is the relationship between abusive head trauma and CMLs? Previous reports have suggested that the acceleration/deceleration forces that occur during shaking may be enough, on their own, to cause CMLs in the extremities.[22,32,33] This report demonstrates that only CMLs of the shoulder are significantly associated with SDH, which is highly concerning for abusive head trauma. This finding might be related to the violent manipulations of the shoulders of the infant during shaking.[12]

We found a predominance of different-age fractures in the group without SDH. This finding might be explained by the fact that children with SDH tend to exhibit neurologic symptoms leading parents to seek care, thereby stopping the abuse.

Little is known about when, and exactly how, a CML is produced. Studies with post-mortem animal or geometric models seem to indicate that the mechanisms responsible for the CML are indirect forces such as bending, torsion, and/or traction forces applied to the extremities.[21,34-37] The fact that fractures similar to CMLs occur during breech deliveries also argues for such indirect forces.[19,38] Our study used detailed confessions, which are known to be rare. This explains the relatively small sample size. Using the selection criteria described in the Methods section, we found 27 cases over a 15-year period for a confession rate of 40%, though this is better than in previous series.[12] There was no significant difference in the demographics or the injuries (localization and number of CMLs, different age fractures, concomitant or previous traumatic injuries, retinal hemorrhage, and SDH) between the 2 groups with or without confessions.

In all of the patients with CMLs who were included in this study, the perpetrators described their actions as violent and deliberate. The perpetrators knew that they had hurt the baby. The mechanisms they described confirm the application of indirect skeletal forces such as "torsion, traction, compression, or forced movements of joints and limbs," sometimes in combination. The most common circumstances of skeletal injury involved physical care of the infant such as diapering and dressing/undressing (74%) and in some cases, feeding. The baby's crying was also cited (less

than one-quarter of cases) as the trigger for the abuse. When perpetrators also described shaking, they clearly differentiated the circumstances and mechanisms of the CML.

As with shaking, two-thirds of perpetrators described the violence as recurrent.[12] They used the words "habitual," "several times a day," or "all the time," making an accurate count impossible. The frequency of the habitual violence responsible for CMLs deserves attention, as it is a strong argument for reporting all suspicious fractures to the legal authorities. And— as with shaking—it explains why dating the injuries is so difficult.

The perpetrators described a cracking sound, loss of mobility, and crying immediately after the violence. In some cases, this increased their violent impulses. However, this shows that, in most cases, the immediate symptoms did not go unnoticed, though they may have been fleeting.

Although this study did not focus specifically on the perpetrators, the strong male predominance should be underscored. In addition, the male perpetrators were far more likely than female perpetrators to cite diapering as the main circumstance of the abuse. These data suggest that public health education should focus on nannies and parents, fathers/stepfathers in particular when addressing this problem.

The limitations of this study are its retrospective design, as is usual in the context of child abuse research. We hopefully minimized this limitation by applying the current recommendations for imaging in suspected child abuse. Another potential concern is that perpetrator admissions are not scientific data. However, the perpetrator statements from court hearings or police questioning are detailed enough for proper analysis and the statements used in this study came from a variety of courts throughout the country.

As expected, the number of legal cases involving nonaccidental fractures is small compared with the several hundred abusive head trauma cases analyzed from the same time period. This can be explained by the fact that in France, there is no national register of child abuse cases and most expert medical opinions are requested in situations potentially involving crimes such as abusive head trauma and sexual abuse. These figures suggest that child abuse cases with fractures are considered "less serious" and so few are subject to expert forensic analysis. ■

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## 50 Years Ago in *The Journal of Pediatrics*

### Esophageal Injury by Liquid Chlorine Bleach: Experimental Study

Weeks RS, Ravitch MM. J Pediatr 1969;74:911-6

By 1969, it was recognized that chlorine bleach was one of the most commonly ingested household items, but the pathophysiology and long-term consequences of the injury were poorly understood. The authors studied the effects of a nondiluted industrial bleach solution on the esophagus using an animal model. They demonstrated universal, progressive mucosal damage over the first week following exposure that often resulted in stricture formation after 1 month. This understanding of the pathophysiology of the injury allowed the development of appropriate interventions, from close observation to endoscopic surveillance to procedural correction of disease as required.

Bleach remains one of the most commonly ingested substances in the pediatric population.[1,2] Thankfully, esophageal injury is rare in pediatrics, because in large part the fact that household bleach has a much lower concentration of sodium hypochlorite solution than its industrial counterpart and the fact that most ingestions are unintentional and therefore, typically involve smaller volumes than seen in adults. However, ingestion of larger volumes of household cleaners can occur due to unlabeled containers or intentional ingestion. Ingestion of higher concentration sodium hypochlorite solutions still occurs in rural communities or in children raised near industrial/farming equipment.[2]

Childproof caps and anticipatory guidance by pediatricians have led to an overall reduction in the number of accidental bleach ingestions. Unfortunately, the number of ingestions from unlabeled containers or spray bottles has remained steady over the last several decades.[1]

Ultimately, although the relative risk of esophageal injury from ingestion of small amounts of household bleach may be low, exposure to household cleaners continues to present a significant risk to children. This suggests that there is more to be done in both advocacy and day to day anticipatory guidance to keep these agents away from the most vulnerable of our patients.

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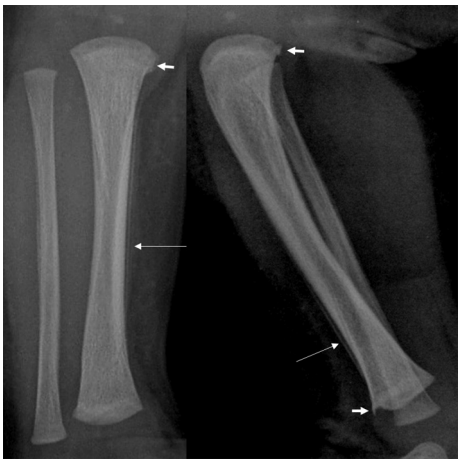

**Figure.** Classic metaphyseal lesions (CML) of the knee and the ankle in a six-week-old infant. Metaphyseal corner fractures of the proximal and distal right tibia (short arrows) have a different appearance, depending on the radiographic projection. Frontal view on the left, lateral view on the right. Thin periosteal thickening is also present (thin arrows).

**Table IV. Features of the group with detailed confessions**

| | Detailed confession for CML n = 27 |
|---|---|
| Sex of perpetrator, n (%) | |
| Female | 8 (29.6%) |
| Male | 19 (70.4%) |
| Circumstances, n (%)* | |
| Diapering | 12 (44.4%) |
| Dressing/undressing | 8 (29.6%) |
| Crying | 6 (22.2%) |
| Feeding or refusal to eat | 4 (14.8%) |
| Mechanism, n (%)* | |
| Torsion | 9 (33.3%) |
| Traction | 9 (33.3%) |
| Compression | 5 (18.5%) |
| Forced movement | 9 (33.3%) |

Excerpts of mechanisms
- "When she cried while I was changing her, I would yank her around and pull her thighs out to the side in an inappropriate way to put on her diaper… It was a violent movement…"
- "I deliberately hurt him repeatedly. It would always happen the same way. I would start changing his diaper, if the baby stayed calm and didn't cry, things would go well; if the baby started crying, things would go badly… Typically, I would push the diaper changing movements too far. To be clear, I didn't make yank him around. I would grab one leg in each hand and lift them up. His legs would be straight and I'd push them as far as they would go toward his head. This put a lot of stress on his knee joints. Let's just say that most of my actions involved the joints. Naturally, the baby would get even more worked up because it hurt and I knew it hurt. The baby's crying would make me lose control even more. Sometimes I twisted his ankles in and out. I would take his heel and turn his foot side to side; it started the night he came home from the maternity hospital. I'd say that in the end it was happening almost daily."
- "For the past month and a half it has gotten worse… It's true that I mistreated them. I twisted their ankles while I was undressing them or when they didn't want me to dress them. I did it to their wrists, too. Once, I was feeding her. She was trying to put her hand into the food container. I grabbed her wrist and pulled it upward."
- "I admit using violence while dressing my daughter or caring for her. I would grab her by the shins hard and pull on her legs to stretch them out so I could put on her clothes. I would hold her legs straight out by putting one hand on her foot and the other on her thigh in order to put on her pants or onesie. The movements were not appropriate. I've used force to hold her leg. I've also yanked on her legs to pull her toward me when she's on her changing table."
- "The fractures must have happened when I folded his legs against his stomach, I did it several times, I did it when he cried from colic. I would lose my temper, take him by the legs and pull them up to his shoulders…"

Differing statements regarding CML and SDH in children with both types of injury
- I held him in front of me, I was holding him under the arms, I don't remember, I didn't shake him for long, just one back-and-forth, and then I set him down hard in his bed. He was on the changing table; I squeezed his legs together, there was no hematoma; I don't understand."
- "I shook my son several times, maybe ten times; I was irritated by his crying. As for the fractures, that must have happened when I folded his legs against his stomach and I took his legs and pulled them up to his shoulders…"
- "I shook him hard several times because he didn't want to eat and I was tired. I picked him up; I held him in front of me and shook him. I changed him on the changing table. I turned him over quickly, his arm must have gotten stuck and I twisted it."

Repeated violence
- "I would wedge his arm under his back and hold his back flat with my arm so that he couldn't move…I did it all the time."
- "I'd say that in the end it was happening almost daily."
- "Once or even twice a week; it depended on how I was feeling and how she was eating."
- "It had become like a habit… at night, I would do it."
- "I admit being violent with my daughter when I handled her while dressing her or caring for her daily."

*Some cases involved multiple circumstances or mechanisms, as described by the perpetrator (total >100%).