

The Life Cycle of Bruises in Older Adults

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OBJECTIVES: To summarize the occurrence, progression, and resolution of accidentally acquired bruises in a sample of adults aged 65 and older. The systematic documentation of accidentally occurring bruises in older adults could provide a foundation for comparison when considering suspicious bruising in older adults.

DESIGN: Between April 2002 and August 2003, a convenience sample of 101 seniors was examined daily at home (up to 6 weeks) to document the occurrence, progression, and resolution of accidental bruises that occurred during the observation period.

SETTING: Three community-based settings and two skilled nursing facilities in Orange County, California.

PARTICIPANTS: One hundred one adults aged 65 and older (mean age = 83).

MEASUREMENTS: Age, sex, ethnicity, functional status, handedness, medical conditions, medications, cognitive status, depression, history of falls, bruise size, bruise location, initial bruise color, color change over time.

RESULTS: Nearly 90% of the bruises were on the extremities. There were no bruises on the neck, ears, genitalia, buttocks, or soles of the feet. Subjects were more likely to know the cause of the bruise if the bruise was on the trunk. Contrary to the common perception that yellow coloration indicates an older bruise, 16 bruises were predominately yellow within the first 24 hours after onset. People on medications known to affect coagulation pathways and those with compromised function were more likely to have multiple bruises.

CONCLUSION: Accidental bruises occur in a predictable location pattern in older adults. One cannot reliably predict the age of a bruise by its color. *J Am Geriatr Soc* 53:1339–1343, 2005.

Key words: bruising; location; duration; color change; causation

A combination of normal age-related changes, common age-related changes, and medications conspire to in-

crease the likelihood of accidental bruising in older adults. Normal age-related changes include a thinning epidermis, increasing capillary fragility, and decreasing subcutaneous fat.¹ Common age-related changes include medical conditions such as diabetes mellitus and leukemia and functional conditions such as falls and gait instability. Many pharmaceutical agents, prescription and nonprescription, may prolong bleeding time. Older adults are more likely to have medical conditions such as atrial fibrillation and osteoarthritis that lead to the use of these medications.

When a child is seen with suspicious bruising, child protective agencies routinely request that pediatricians document the injury, estimate the age of the injury, and support or refute claims of child abuse.² With the increased awareness of the estimated 1 million to 2 million cases of elder abuse, people such as Adult Protective Services workers, law enforcement officers, and prosecutors are similarly looking to geriatricians and others in the medical community for input in elder mistreatment cases involving clients with extensive bruising.³

This poses a special challenge to geriatricians, given the high prevalence of accidental bruises in older adults. Although there is a body of research on the site, pattern, and dating of bruising in children, similar research in the geriatric population does not exist. The first step in building this literature is the documentation of common bruising patterns in the geriatric population. The systematic documentation of accidental bruising in older adults could provide a foundation for comparison when considering suspicious bruising, as may occur in situations of abuse. To that end, the goal of this study was to summarize the occurrence, progression, and resolution of accidental bruises in a sample of adults aged 65 and older.

Given the paucity of research on bruises in the geriatric population, it is helpful to review what is known about bruising in children. A study of accidental bruising in children and adolescents (n = 1,467) found that most children had one or more bruises (76.6%), with less than 2% of the bruises occurring on the buttocks, pelvis, abdomen, or thorax and less than 1% of the bruises occurring on the chin, ears, or neck.⁴ Another study compared children who had been bruised as a result of abuse (n = 133) with children who had been accidentally bruised (n = 189). Children who were abused had more bruising, especially on the head, neck, and trunk than those who had not been abused.⁵

Because of the biochemical changes in the bilirubin molecule as it is broken into its constituent parts, bruises

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tend to change color in a predictable sequence from purple/black to green to yellow, with red appearing anywhere throughout the duration of the bruise. The only study to compare bruising color changes between young and old (≥ 65) found that bruises in older subjects developed yellow color at a slower rate, although the time difference was not specified.⁶ Textbooks on forensic medicine have included charts on dating a bruise by color,⁷⁻⁹ but the American Academy of Pediatrics' Continuing Medical Education course on bruising and skin trauma (2000) states "that bruising charts for determining the age of bruises are unreliable. The scientific basis for these charts is tenuous and does not allow for accurate dating of bruises."^{1,10} Moreover, physician estimates of the age of bruises have been shown to be inaccurate when the bruises are presented as photographic evidence,¹¹ as well when bruises are observed directly in a physical examination.¹

Based upon what is known about bruising in children and what is known to differ between children and older adults, five research questions guided this study.

1. Do accidental bruises occur in predictable locations in older adults?
2. Do color changes in bruises occur in a predictable pattern in older adults, and is it possible to date a bruise by its color?
3. How do medications and medical conditions that interfere with normal blood clotting affect bruising in older adults?
4. Do older adults with compromised mobility or functional ability have more bruises?
5. When a bruise occurs in an unusual location, is the older adult more likely to know how it occurred?

METHODS

Study Population

Between April 2002 and August 2003, 101 subjects were recruited from three community-based independent living settings ($n = 77$) and two skilled nursing facilities ($n = 24$) in Orange County, California. Inclusion criteria required that subjects be aged 65 and older, able to provide informed consent or assent to surrogate consent in accordance with California law, and reside in the community or a skilled nursing facility (SNF) research site. If a bruise had been suspected to be the result of abuse, the subject would have been excluded from the study and the case reported to Adult Protective Services or ombudsman. A research team trained in elder abuse detection made this determination through home visits. The assessments included subjects and their caregivers or family members living with them. In the recruitment and study periods, there was no suspicion of elder mistreatment.

Similar to the population of the surrounding community and SNF settings, the study population was 66% female, had an average age of 78, and was all Caucasian. Seventy-seven percent of study participants ambulated independently at home, and 55% of the sample was independent with all activities of daily living (ADLs). Twenty-one percent were competent in all instrumental activities of daily living (IADLs), whereas 27% were unable to perform IADLs, even with help.

All of the subjects were queried on their medical conditions and use of prescription and over-the-counter medications. All of the subjects, except one, were on prescribed medications with a mean of 6.7. Eighty-six percent of the sample was taking over-the-counter medications with a mean of 3.6.

Eighty-nine percent of subjects scored 10 or under on the 30-item Geriatric Depression Scale indicating not depressed. On the Folstein Mini-Mental State Examination, 88.3% of the sample scored 24 or greater. A subject was considered cognitively impaired if he or she had a legally authorized representative as a result of documented incapacitation; or was deemed to be impaired by the geriatrician on the research team who evaluated capacity of all potential subjects who showed any confusion or disorientation to time, place, or person. Seventeen subjects assented to surrogates in the informed consent process.

Data Collection

Once a subject was enrolled in the study, one of two trained research assistants went to his/her home each day at approximately the same time of day (± 2 h) and examined the subject from head to toe for any bruises. The subject undressed fully so that the entire body was examined. If a bruise was present at the first visit, this bruise was documented and that bruise was not included in the study. If a new bruise appeared during the 14-day inspection period, it was known to have occurred during the prior 24 hours and was then documented every day until resolution or until 6 weeks had passed. Subjects and/or caregivers were asked if they knew what caused the bruise.

Because subjects were examined every day for as much as 6 weeks, it was necessary to have two interviewers collecting data. Because of the subjective nature of color perception, the color assessments of both interviewers were compared daily to address interrater reliability. Color charts (including paint chip samples); a clear, pliable, circular measurement tool; review of notes and photographs; and periodic in-person inspection of bruises by both researchers at the same time were used to assure agreement among raters throughout data collection.

MEASURES

The location, size, and colors of each bruise were measured every day until resolution. Each bruise was inspected, documented, and digitally photographed. Functional status was measured using the Katz ADL¹² and Lawton IADL¹³ scales. Mobility was measured using the Tinetti Gait and Balance¹⁴ and Ambulation Scale. Subjects or their proxies were asked to report how many falls they had had in the previous week, month, 6 months, and year. The names, dosage, and frequency of usage were recorded for each prescribed and over-the-counter pharmaceutical.

ANALYSIS

Quantitative data were analyzed using SPSS version 11.0 (SPSS Inc., Chicago, IL). The distribution of all variables was examined through inspection of frequencies. *T* tests were used to test differences in means, chi-square tests were used to determine relationships between categorical variables, and correlations were used to summarize relationships between continuous variables.

RESULTS

Location and Size of Bruises

One hundred one participants were screened; 73 had at least one bruise occur in the 2-week initial inspection period. Of the 73 participants with bruises, 49 had one bruise, 17 had two bruises, three had three bruises, three had four bruises, and one had five bruises, for a total of 108 bruises. Of the 108 bruises, 89% were on the extremities, and of those, 76% were on the dorsal arms. Those who needed assistance with ADLs were more likely to have multiple bruises, but there was not a significant difference in the location, size, or color of the bruises. No bruises were observed on the neck, ears, genitalia, buttocks, or soles of the feet. Figure 1 depicts the location, size, and primary initial color of the 108 bruises.

The area of the bruises varied from 0.12 cm² to 50.0 cm² (mean ± standard deviation = 3.42 ± 6.72) with widths ranging from 0.3 cm to 10.0 cm. There was not a statistically significant difference between the occurrence of bruises on one side of the body and the other or a correlation between handedness and location.

Ability to recall the cause of a bruise varied by location of the bruise. When the bruise was on the trunk (n = 12), 42% of subjects knew how the bruise occurred. In contrast, when the bruise was on the extremity (n = 96), 17% of subjects knew how the bruise occurred (P = .04). Of those who knew the mechanism of the bruise, most reported bumping into something, and two reported falling.

There was not a significant correlation between depression and bruising.

Timing and Sequence of Color Change

The period that the bruises were visible varied from 4 to 41 days (mean = 11.73 ± 7.13). Half of the bruises (54%) resolved by Day 6, and most (81%) resolved by Day 11. As depicted in Figure 2, in the first 48 hours, most bruises were observed as red (90%) and/or purple (80%), with fewer displaying black (25%), yellow (20%), green (10%), and blue (8%).

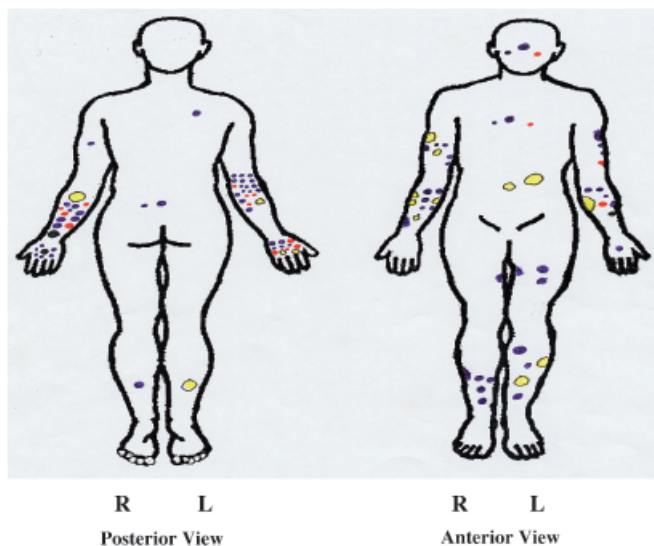


Figure 1. Combined summary of 108 bruises observed on 73 subjects at Day 1.

Table 1. Bruise Area by Location Cross-Tabulation

Size of Bruise in Greatest Dimension cm	Bruise Locations by Trunk and Extremities		Total
	Trunk	Extremities	
	n (%)		
Small (0.1–1.0)	5 (41.7)	31 (32.3)	36 (33.3)
Medium (1.1–4.9)	6 (50.0)	46 (47.9)	52 (48.1)
Large (5.0–50)	1 (8.3)	19 (19.8)	20 (18.5)
Total	12 (100.0)	96 (100.0)	108 (100.0)

Consistent with the pediatric literature, red was observed throughout the duration of the bruise. On Days 1 through 6, 90% of the bruises contained red, and more than 20% of bruises contained red for 2 weeks, with some bruises containing red all the way up to 6 weeks. Purple was prevalent in the first 3 days of the bruises' life cycle (> 80% contained purple color), declined rapidly over the next 11 days, and was uncommon (< 5%) thereafter.

Yellow increased over time for the first 6 days, with nearly 60% of bruises showing yellow at Day 6. Sixteen percent of the bruises included yellow on Day 1. After Day 6, yellow was present in 30% of the cases and was the most common color present in bruises that were more than 3 weeks old.

Relationship to Medications and Medical Conditions

All of the subjects except one were taking at least one prescribed medication, with a mean of 6.7 medications. Eighty-six percent of the sample was taking over-the-counter medications, with a mean of 3.6 over-the-counter medications.

With advice from a pharmacist who specializes in geriatric pharmacology, medications were divided into three categories: no effect (53%), minimal effect (7%), and at least moderate effect (40%) on bleeding time/bruising. Of those on medications expected to have at least a minimal effect on bleeding time/bruising, 46% had multiple bruises. Of those not on such medications, 26% had multiple bruises (P = .08). There was no significant correlation between medications known to interfere with coagulation pathways and the duration of bruises or color change.

Residential to Function

There was a statistically significant difference in the number of bruises between those who required assistance with one or more ADLs and those who required no assistance. Fifty percent of those who required ADL assistance had two or more bruises, as opposed to 25% of those not requiring ADL assistance (P = .04). There was no relationship between ADLs and the location of the bruises or days until resolution.

Residential Setting

Of those residing in a SNE, 79% developed a new bruise during the 2-week observation period, which was similar to the rate of 71% of those living in the community. Eighteen

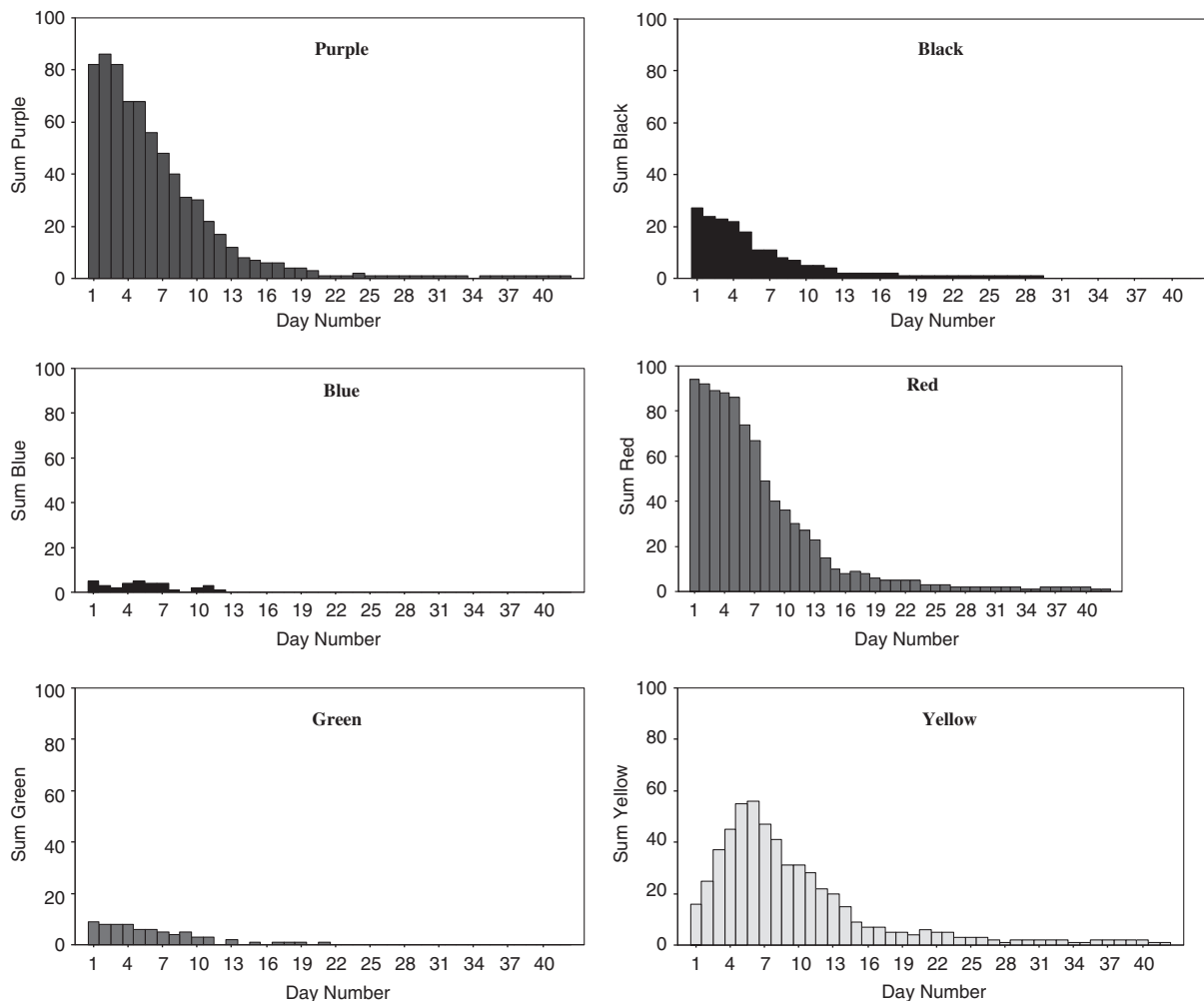


Figure 2. Progression of color by day.

percent of SNF subjects with bruising had bruising on the trunk, compared with 9% of those in the community, although the difference was not statistically significant. There was no correlation between residential setting and location of the bruise on the trunk as opposed to the extremities or to days to resolution.

Mobility

No significant difference was observed in the number, location, or duration of bruises between those who ambulated independently and those who used assistive devices at home or in the community.

Three subjects had fallen in the preceding week, seven in the previous month, 10 in the previous 6 months, and 23 in the previous year. Two of the bruises in this study were reported to have been the result of a fall.

On the Tinetti Gait Assessment, a score of 12 indicates a steady gait.¹⁵ Scores ranged from 1 to 12, with a mean of 9.25 ± 2.19 . On the Tinetti balance assessment, a score of 16 indicates steady balance, and 0 indicates significant problems with balance. Scores ranged from 3 to 16, with a mean of 11.82 ± 3.27 . No significant correlation was observed between gait or balance and number or location of bruises.

DISCUSSION

In a first step toward building knowledge on the medical forensic aspects of bruising, this study sought to document the occurrence and progression of accidental bruising in the geriatric population. The results of this study suggest that accidental bruises occur in a predictable pattern in older adults. Nearly 90% of the bruises were on the extremities, and in daily observation of 101 older adults, not a single accidental bruise was observed on the neck, ears, genitalia, buttocks, or soles of the feet. Most large bruises that occur accidentally are on the extremities. Of the 20 large bruises (5–50 cm) in this study, only one was on the trunk. Moreover, older adults are significantly more likely to know how the bruise happened if the bruise is on the trunk.

Although a discernible pattern is observed in the location of the bruises, the initial color and color change over time are less predictable. Contrary to the perception that yellow indicates an old bruise, 16 bruises were predominantly yellow on the first day of observation, and 30 bruises were largely purple on the 10th day of observation. Consistent with the pediatric literature, red was observed throughout the life of the bruise.

Medications that interfere with normal blood clotting have an effect on bruising in older adults. Subjects taking

medications known to have at least a minimal effect on coagulation were more likely to have multiple bruises, although the bruises were not larger and did not take longer to resolve. It is not surprising that older adults with compromised functional ability were more likely to have multiple bruises because they are more likely to bump themselves and more likely to be touched/handled by others.

Research is needed on accidental bruising in older adults from various racial and ethnic backgrounds. In addition to increasing understanding of bruising in seniors with various skin tones, data from an ethnicity study could be coupled with existing data to increase the sample size and potentially provide more definitive results on such variables as medications, medical conditions, and functional ability.

A limitation of this study is that it was not possible to be 100% sure that all bruises were accidental. Subjects were asked about abuse, and the research assistants were trained to look for suspicious circumstances such as poor interpersonal dynamics between subjects and caregivers, evidence of physical restraint use, evidence of fear on the part of subjects, or evidence of attempts to isolate the subjects. No such suspicious circumstances were identified.

Another limitation of the study was that the study population was not randomly selected. Because participation in the study required a great commitment on the part of the research subjects (willingness to be seen every day, without clothing, for up to 42 consecutive days), logistical/funding constraints necessitated that participants live close to one another. It was helpful that the independent and skilled nursing communities had a culture supportive of research participation as a way to contribute to society.

It is critical to learn more about bruising in older adults. It is a common phenomenon and may therefore be accepted as normal, unavoidable, usual, and expected. Although this is the case in many circumstances, there is also the reality that millions of American seniors are injured, exploited, and mistreated by people on whom they depend for care and protection. The next step in building this literature is to conduct research on bruising known to have been inflicted as a result of physical elder abuse. Understanding the etiology and life cycle of accidental and inflicted bruises in older adults can help identify older adults who have been abused and, equally important, protect caregivers from being unfairly accused of abuse.

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