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Low-Cost Earmuff Shown to Significantly Reduce Cast-Saw Noise

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Hearing protection devices reduce cast-saw noise. It would be helpful to identify the devices that are both effective and economical. Prior studies have shown that expensive noise-reduction headphones significantly reduced the anxiety associated with cast removal with a powered oscillating saw. The cost of such headphones, however, is a drawback for some practices and hospitals. It would be helpful to determine whether lower cost ear protection can provide effective cast-saw noise reduction. In addition, it is unclear whether the noise reduction ratings (NRRs), the average sound-level reduction provided by a hearing protection device in a laboratory test, provided by manufacturers accurately characterize the effectiveness for reducing cast-saw noise. Note that noise-cancelling devices do not carry an NRR because they are not designed as hearing protectors. Five ear protection devices with different NNRs were tested. The devices varied greatly in cost and included earplugs, low-cost earmuffs, and noise-cancelling headphones. To standardize the evaluation, each device was fitted to an acoustic mannequin with high-fidelity ear microphones while a fiberglass spica cast was cut. An additional test was run without hearing protection as a control. The low-cost devices significantly reduced the saw noise, with the exception of earplugs, which had highly variable performance. The noise reduction was similar between low-cost earmuffs and the high-cost earphones when the noise-cancelling feature was not active. Active noise cancelling provided further reductions in the noise level. Patients can experience high anxiety during cast removal. The current study shows that low-cost earmuffs significantly reduce cast-saw noise. Patient care settings may be more likely to offer hearing protection that is one twenty-fifth the cost of noise-cancelling headphones. An NRR appears to be a reliable guide for selecting hearing protection that reduces cast-saw noise.

Introduction

Nonoperative management of fractures remains a cornerstone of orthopaedics (Court-Brown et al., 2010). This is particularly true in the pediatric population, where the remodeling potential of fractures allows for greater acceptable tolerances with closed reduction and casting (Wilkins, 2005). A review of two Scottish hospitals in 2000 demonstrated that 67.6% of adult fractures and 91.6% of pediatric fractures were managed nonoperatively (Court-Brown et al., 2010). To remove these casts, cast saws have been used for nearly 75 years, with the original patent submitted by Homer Stryker in 1945 (Stryker, 1945). Modern cast saws utilize an oscillating blade, which cuts through the hard outer surface of the cast while preventing injury to the soft tissue underneath (Halanski, 2016). These saws are attached to a vacuum to help reduce the temperature of the blade and capture debris (Killian et al., 1999; Puddy et al., 2014). Although complications with cast-saw removal are rare, burns and cuts do occur (Puddy et al., 2014). However, the combined vacuum and saw creates a loud environment that has raised concern in the past about potential hearing loss for cast-saw operators and patients alike (Marsh et al., 2011; Post et al., 2013). Several studies have shown that the sound produced from cast removal does not exceed hazardous levels for human hearing (Marsh et al., 2011; Post et al., 2013). Despite the lack of physical harm, the noise associated with the procedure itself can create an anxiety-provoking environment for patients, especially pediatric patients (Carmichael & Westmoreland, 2005; Katz et al., 2001; Mahan et al., 2015; Liu et al., 2007).

Various modalities to decrease patient anxiety associated with cast removal have been studied. One group examined the effects of lullaby music to help reduce

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The authors have no conflicts of interest to disclose.

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DOI: 10.1097/NOR.0000000000000774

patient anxiety during these procedures (Liu et al., 2007). Another used videos or games during cast removal to distract patients (Ko et al., 2016). Certified child life specialists (CCLS) have been used to help address patient anxiety during cast removal (Schlechter et al., 2017). However, the most commonly recognized method in the literature to reduce patient anxiety is the use of hearing protection or noise-cancelling devices (Carmichael & Westmoreland, 2005; Katz et al., 2001; Mahan et al., 2015). More recent studies have utilized noise-cancelling headphones with media devices, which have also demonstrated similar anxiety-reducing results (Mahan et al., 2015).

Given the evidence of cast removal-induced anxiety in the literature, the need for a cost-effective and easily implemented protocol to address this sequela is warranted (Carmichael & Westmoreland, 2005; Katz et al., 2001; Mahan et al., 2015; Liu et al., 2007). To the authors' knowledge, there are no such recommendations currently available. Furthermore, no studies have compared different forms of hearing protection during cast removal in a controlled environment. In the current study, the noise-reducing efficacy of various forms of hearing protection was compared during cast removal. The measured sound levels were also compared with those estimated using the noise reduction rating (NRR) indicated on the product label for each device, except the noise-cancelling headphones for which no NRR was indicated. The NRR is measured by each manufacturer using white noise at the lower threshold of hearing (ISO 4869-1:2018E). It is unclear whether these ratings are predictive of performance for the cast-saw noise.

The main goal of the study was to determine whether inexpensive forms of hearing protection provide similar noise reduction in comparison with more expensive models. A secondary goal was to determine whether NRRs provided by manufacturers correspond to cast-saw noise-level reductions. It was hypothesized that inexpensive hearing protection with high NRRs will perform similarly to more expensive models.

Materials and Methods

To create a controlled test environment, all tests occurred within an anechoic (sound-absorbing) chamber using a binaural recording mannequin (Aachenhead; HEAD Acoustics, Herzogenrath, Germany) (see Figure 1). The mannequin simulates the anatomical sound-filtering experienced when listening with two ears, with high-fidelity microphones in the mannequin's left and right ears for sound recording. Five forms of hearing protection, including low-cost and more expensive models (see Table 1), were tested: two low-cost earmuffs (LC1, LC2), earplugs (EPs), active noise-cancellation headphones with the cancellation feature on (ANC), and the same headphones with the cancellation feature off (ANC OFF). The ANC OFF setting was selected as a test condition because the batteries of the headphones could potentially lose charge or someone could forget to turn the noise-cancelling feature on. As a control, recordings were also made without any hearing protection devices covering the mannequin's ears.

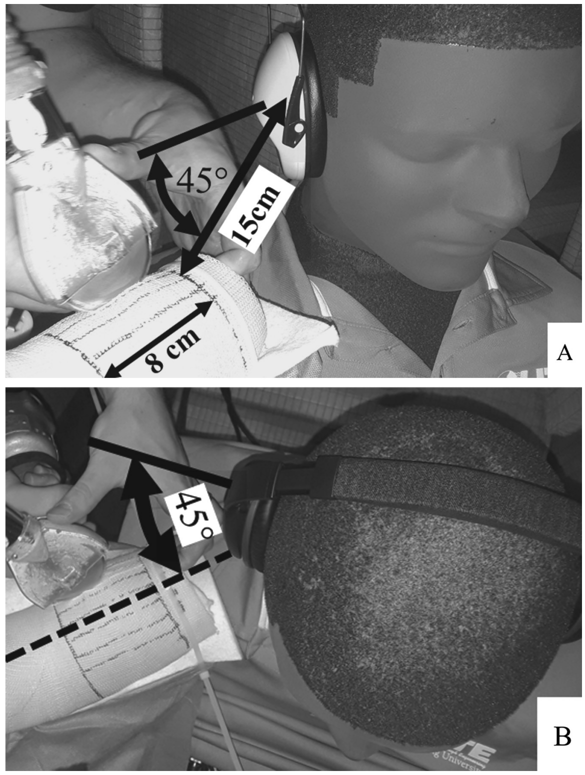

Figure 1. An acoustical mannequin was used as a surrogate for a patient undergoing cast removal. Microphones positioned in the ear canal and the accompanying anatomy of the head, face, and ear are designed to mimic human hearing. The cast was positioned such that the start of the cuts was positioned 15 cm from the center of the external auditory meatus (A) and 45° inferiorly and anteriorly (B) from the ear. Cuts of 8 cm were made parallel to the longitudinal axis of the cast along premarked paths.

The leg portion of five previously used hip spica fiberglass casts were selected for the study. These were readily available from previous work performed by the research team. Lines for the planned cuts were marked parallel to the long axis of each cast in 6-mm increments starting 13 mm from the lateral edge of the cast. Each of these cutting guide lines on the cast were approximately 8 cm in length (see Figure 1). The cast structure and thickness in the area marked were similar for all five casts. Each cast yielded one recording for each protective device plus control, performed in randomized sequence, yielding five tests per device. The casts were clamped to a wood board that approximated the diameter of a child's arm. The board was positioned in space relative to the mannequin's head with a fixture; the floor of the anechoic chamber was marked to ensure the fixture was in the same position for all trials. A piece of 6-mm thick casting felt was placed over the simulated arm board before clamping the cast in place to simulate the soft tissues and prevent excessive vibration of the cast against the board. The cast was placed at a 45° angle both anteriorly and inferiorly 15 cm from the mannequin's ear (see Figure 1). This distance has been shown to represent the position of a long-arm cast from a child's ear (Post et al., 2013). For each cast, the order

Table 1. Four Hearing Protection Devices Were Evaluated for Sound Reduction When Cutting a Fiberglass Cast Using a Cast Saw

Identification	Description	Cost
Low cost 1 (LC1)	Protective earmuff with 27-dB NRR marketed for pediatric use	<$20
Low cost 2 (LC2)	"Professional earmuff" with 26-dB NRR, marketed for adult and pediatric use	<$20
Active noise cancellation headphones (ANC)	Headphones with noise cancellation feature marketed to adults (cost >$100); per the manufacturer's literature, the NRR is not available for this device	>$100
Earplug (EP)	Disposable polyurethane earplug with an NRR of 32	<$20 quantity of 80

Note. NRR = noise reduction rating. The active noise-cancelling headphones were tested both with and without the active noise-cancelling feature, for a total of five different hearing protection devices.

of the hearing protection tested was randomly assigned to one of the six prelabeled lines. This was to mitigate any influence of the cutting order on the sound levels. The same person fitted each form of hearing protection for all of the trials to ensure repeatable ear coverage. For the earplugs, each piece of foam was placed as deep as possible into the mannequin's ear and then removed approximately 6 mm. This prevented the earplug from resting against the microphone screen and obstructing any possible transmission of sound.

Recordings made with the recording mannequin used research-grade precision microphones placed within the ear canal. Sound samples were collected at 44.1 kHz, with a 32-bit float sample format using the Free Field equalization outputs from the signal conditioner and a Scarlett 2i2 audio interface from Focusrite (High Wycombe, England). The input level on the signal conditioner was set at a 104-dB input range to ensure there would be no clipping. With these settings, the audio signal was captured with high fidelity, without distortion, and incorporated diffraction and other subtle filtering effects related to the shape of the head. These input-level settings were constant throughout all recordings. Before the first test series, the baseline sound level was measured at the center of the near-side pinna using a Larson Davis Model 812 Type 1 sound-level meter (Depew, NY), field calibrated using a Larson Davis CAL200 acoustic calibrator (Depew, NY). This measure was utilized to convert dB levels to dB(A), which incorporates varying levels of hearing sensitivity with frequency. In broad terms, humans tend to be most sensitive to sounds with frequencies around 1,000–4,000 Hz and much less sensitive to frequencies below 200 Hz or so; the A-weighting accounts for this sensitivity by reducing amplitude of those low frequencies that humans do not hear as well. Because the A-weighted sound pressure level is thus tied to human perception, earlier studies reported their data using the dB(A) scale. For each trial, approximately 5 seconds of sound data were recorded while the cast saw (Stryker 9003-210 Cast Cutter with Plaster Vac Model 855 System; Kalamazoo, MI) cut the cast. The same researcher used the cast saw for all trials.

The near-side ear (facing the cast) sound data files were analyzed (Audacity, audacity.org) with a contrast function to compare artificially generated silence, or zero, against the root mean square (RMS) sound level for a 2-second sample taken from the most intense sound from the given recording. One individual clipped the audio files to the most intense 2-second span and performed all analyses. This contrast value was then converted to dB(A) using the baseline sound measurement taken at the start of the test series to allow comparison with data from previous studies (Marsh et al., 2011; Post et al., 2013).

Sound levels, dB(A), for each protective device were compared against the control experiments (no hearing protection) using a repeated-measures analysis of variance (n = 5 for all devices except ANC where one test was cut short and could not be analyzed), with pretests for normality (Shapiro–Wilk) and equal variance (Brown–Forsythe) and post hoc pairwise multiple comparisons (Holm–Sidak) (Sigma-Plot; Systat Software Inc., San Jose, CA). A similar analysis was utilized to compare the sound levels between the five forms of hearing protection. The EP data did not pass the test for normality (Shapiro–Wilk), so it was compared with the control using a nonparametric test (Mann–Whitney rank sum test). Significance was α = .05 for all comparisons. Expected dB(A) levels based on NRRs were calculated on the basis of methods outlined by the Occupational Safety and Health Administration ([OSHA]; OSHA Standard 1910.95 App B, 2019).

Results

Of the five types of hearing protection devices tested, four demonstrated significant reductions in dB(A) in comparison with the control (see Figure 2). These included LC1, LC2, ANC, and ANC OFF. The EP data presented a large range of variation and were not significantly different from the control (median EP = 90.23 [quartile = 81.42–94.97] vs. median control 94.15; p = .22, Mann–Whitney test). When comparing the expensive and inexpensive forms of hearing protection, ANC demonstrated significant reductions in dB(A) compared with all other forms of hearing protection. For all other devices, there were no significant differences when comparing between the various models (LC1 vs. LC2, LC1 vs. ANC OFF, LC2 vs. ANC OFF). The NRR was available for the two low-cost hearing protection devices tested. For these devices, the expected reduction in dB(A) based on the NRR was similar to the mean level recorded in the study (see Table 2).

Discussion

Hearing protection is helpful in reducing anxiety in pediatric patients during cast removal (Carmichael & Westmoreland, 2005; Katz et al., 2001; Mahan et al.,

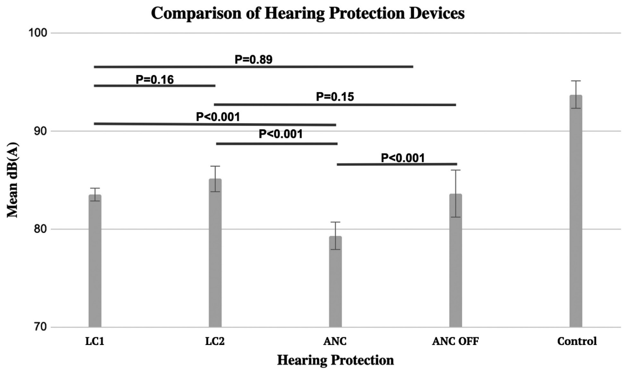

FIGURE 2. All of the hearing protection devices demonstrate significant reductions in dB(A) when compared with the control without ear protection ($p < .001$). ANC demonstrated significant reductions in dB(A) when compared with LC1, LC2, and ANC OFF ($p < .001$). There was no significant difference between LC1, LC2, and ANC OFF (see p values for comparisons on the upper three bars in the figure). EP was not included because of the lack of normality in the data and a wide variation secondary to inconsistent fit. There was no significant difference between control and EP ($p = .22$). ANC = active noise-cancellation; EP = earplug; LC1 = low-cost earmuff 1; LC2 = low-cost earmuff 2.

2015). To the authors' knowledge, studies have not compared different forms of hearing protection during cast removal in an acoustically controlled environment. The current study hypothesized that the inexpensive hearing protection would perform similarly to the more expensive models. The findings demonstrate that the inexpensive (LC1, LC2) and expensive (ANC, ANC OFF) models all significantly reduced the dB(A) in comparison with the control. The ANC performed significantly better than the less expensive forms of hearing protection. However, this was not the case for the ANC OFF, which did not show a significant difference when compared with the less expensive earmuffs. The NRR, which manufacturers measure using white noise (sound at all frequencies at a constant level) in a standard test described by the American National Standards Institute, appears to be an accurate measure of the expected reduction in dB(A) for cast-saw noise. Before testing, it was unclear whether the NRR would predict blockage of the cast-saw noise, which has multiple frequency peaks, and the NRR was not available for the more expensive noise-cancelling headphones. The low-cost hearing protection performed slightly better than anticipated and reduced the mean dB(A) level below the expected value based on the NRR.

The EP demonstrated large variations across all five casts tested. This was attributed to the difficulty in ensuring repeatable placement within the mannequin's ear canal. The amount of compression of the earplugs before placing them in the ear, the depth of insertion, and the level of retraction for each trial were challenging to repeat. This is evident in the data with the first EP test reducing the sound to 77.1 dB(A) versus the fifth cast demonstrating an increase compared with the control at 97.1 dB(A). This increase was likely due to a loose fit, which may have compromised the sound blocking provided by the EP, subsequently increasing the decibel level.

Similar to the findings of Post et al. (2013), the sound recorded from cast removal did not exceed the single-intensity exposure defined by the National Institute for Occupational Safety and Health (NIOSH). Post et al. (2013) reported an average dB(A) level of 99.4 and 96.4 for two separate cast saws recorded in their study. This is similar to the 94 dB(A) average sound intensity without hearing protection in the current study. It is suspected that the slightly lower value recorded in the current study is related to the anechoic chamber, which limits the noise retained in the room by the sound reflecting back from the walls and other objects in the cast removal room in clinical studies. Conversely, Marsh et al. (2011) demonstrated an average of 75.9 dB(A) when cast technicians wore acoustic dosimeters on their shirt collar during an 8-hour workday. The difference is likely related to the distance from the recording device to the cast saw, as it is unlikely for the saw to be 15 cm from the technician's shirt collar during the cast removal process (Post et al., 2013). The current study used a 15-cm distance because it represents a common distance from the cast saw to a pediatric patient's ear during cast removal.

Several authors have already demonstrated the benefit of hearing protection in reducing anxiety during cast removal. Mahan et al. (2015) showed that the use of expensive (~$280) noise-cancelling headphones (Bose Noise Cancelling Headphones, Framingham, MA) in conjunction with a media device led to lower face, leg, activity, cry, consolability scale (FLACC) scores during removal compared with controls. Conversely, Carmichael and Westmoreland (2005) and Katz et al. (2001) utilized earmuffs that currently retail from approximately $10 to $35, with NRRs of 25 and 29 dB, and demonstrated that these result in significantly lower increases in heart rate (Carmichael & Westmoreland, 2005; Katz et al., 2001; Mahan et al., 2015) compared to no hearing protection. In the current study, it was confirmed that both inexpensive earmuffs and expensive

TABLE 2. The Expected Reduction in dB(A) Was Compared With the Actual Reduction for Both Low-Cost Devices Based on the Manufacturer's Reported NRR

Hearing Protection	Mean Control, dB(A)	NRR, dB	Expected Reduction, dB(A)[a]	Mean Recorded dB(A)
LC2	94	26	86	85
LC1	94	27	84	83

Note. dB = decibel; LC1 = low-cost earmuff 1; LC2 = low-cost earmuff 2; NRR = noise reduction rating.
[a]Calculated per the following equation: (NRR − 7)/2 = actual expected decrease in dB(A).[15] For example, for LC1, (27 − 7)/2 = 10 dB(A), so based on the NRR, a 10-dB(A) reduction is expected with LC1 usage.

ANC headphones significantly decreased the dB(A) in comparison with no hearing protection and the NRR appears to provide a reliable estimate of the earmuff's ability to decrease cast-saw noise. These lower cost options may be attractive for implementation in a clinical setting. Although the current study cannot comment on the efficacy of the tested hearing protection in reducing anxiety directly, it does show that inexpensive earmuffs are viable options for reducing overall sound levels during cast removal.

The study is not without limitations. Although the anechoic chamber and the mannequin enabled a more accurate and consistent measurement of sound during cast removal, the mannequin is imperfect. The pinnae are rigid rather than flexible, which may alter the fit of the hearing protection. The hearing protection device seal was verified prior to the start of each trial to ensure best fit. In addition, the position of the earplugs within the ear canal was inconsistent, which led to a large variation in results among trials. Although this is considered a limitation from a data collection perspective, it may highlight the difficulty of achieving a perfect fit in real-world situations. Furthermore, there was some concern that the brightly colored earplugs could be enticing for young pediatric patients, as they may resemble candy. In fact, a warning on the products box recognizes the earplugs are considered a choking hazard and should not be used in individuals younger than 3 years. Based on this concern, the earmuff-type protection seems preferable. Another limitation was the use of the halved hip spica casts for the study, rather than actual long-arm cast on a subject. There is a chance that the acoustic nature of the sound is different in the latter. However, the goal of the study was to compare the various forms of hearing protection and the similar size, shape, and thickness of the spica cast readily allowed for this comparison.

Both inexpensive and expensive hearing protection devices significantly reduced the noise recorded during cast removal. Although the ANC reduced the dB(A) significantly more than the low-cost earmuffs, based on the NRR and the studies previously mentioned, it appears that both forms would be acceptable for use as hearing protection during cast removal (Carmichael & Westmoreland, 2005; Katz et al., 2001; Mahan et al., 2015). The current study confirms that low-cost hearing protection is a viable option and that the NRR should be used as guidance when selecting a given model.

Acting as a patient advocate is one of the crucial roles of any nursing professional. Nurses will typically spend more time with patients than any other member of the healthcare team. Orthopaedic nurses specifically have to be equipped to deal with patient care elements unique to orthopaedics, including cast and splint care. The orthopaedic nurse is in a position to be aware of the anxiety and fear associated with cast removal—in both the pediatric population and adults who are sensitive to loud noise or fear medical procedures. This study provides orthopaedic nurses with evidence when advocating for their patients. It shows that a low-cost device significantly reduces cast-saw noise and can be easily implemented in a range of care settings to help ease the stress associated with cast removal and improve the patient experience.

Acknowledgments

The authors appreciate the use of the Kettering University Acoustics Lab and the assistance of Nikhil Mukkamala and Robert McMahan (III) for their work to support the initial development of this study.

References

Carmichael, K. D., & Westmoreland, J. (2005). Effectiveness of ear protection in reducing anxiety during cast removal in children. *American Journal of Orthopedics (Belle Mead, NJ)*, *34*(1), 43–46.

Court-Brown, C., Aitken, S., Hamilton, T., Rennie, L., & Caesar, B. (2010). Nonoperative fracture treatment in the modern era. *The Journal of Trauma: Injury, Infection, and Critical Care*, *69*(3), 699–707. https://doi.org/10.1097/TA.0b013e3181b57ace

Halanski, M. A. (2016). How to avoid cast saw complications. *Journal of Pediatric Orthopaedics*, *36*(4), S1–S5. https://doi.org/10.1097/BPO.0000000000000756

ISO 4869-1:2018E.(2020). *Acoustics—Hearing protectors—Part 1: Subjective method for the measurement of sound attenuation*. https://www.sis.se/api/document/preview/80007078

Katz, K., Fogelman, R., Attias, J., Baron, E., & Soudry, M. (2001). Anxiety reaction in children during removal of their plaster cast with a saw. *The Journal of Bone and Joint Surgery*, *83*(3), 388–390. https://doi.org/10.1302/0301-620x.83b3.10487

Killian, J. T., White, S., & Lenning, L. (1999). Cast-saw burns: Comparison of technique versus material versus saws. *Journal of Pediatric Orthopaedics*, *19*(5), 683–687. https://doi.org/ 10.1097/00004694-199909000-00026

Ko, J. S., Whiting, Z., Nguyen, C., Liu, R. W., & Gilmore, A. (2016). A randomized prospective study of the use of iPads in reducing anxiety during cast room procedures. *Iowa Orthopaedic Journal*, *3*, 128–132.

Liu, R. W., Mehta, P., Fortuna, S., Armstrong, D. G., Cooperman, D. R., Thompson, G. H., & Gilmore, A. (2007). A randomized prospective study of music therapy for reducing anxiety during cast room procedures. *Journal of Pediatric Orthopedics*, *27*(7), 831–833. https://doi.org/10.1097/BPO.0b013e3181558a4e

Mahan, S. T., Harris, M. S., Lierhaus, A. M., Miller, P. E., & DiFazio, R. L. (2015). Noise reduction to reduce patient anxiety during cast removal: Can we decrease patient anxiety with cast removal by wearing noise reduction headphones during cast saw use? *Orthopaedic Nursing*, *36*(4), 271–278. https://doi.org/10.1097/NOR.0000000000000365

Marsh, J. P., Jellicoe, P., Black, B., Monson, R. C., & Clark, T. A. (2011). Noise levels in adult and pediatric orthopedic cast clinics. *American Journal of Orthopedics (Belle Mead, NJ)*, *40*(7), E122–E124.

OSHA Standard 1910.95 App B. (2019). *Methods for estimating the adequacy of hearing protection attenuation*. Retrieved October 17, 2019, from https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.95AppB

Post, J. M., Switzer, K. D., Brown, D. K., Meinzen-Derr, J., Dively, J., Dunkin, B. S., & Mehlman, C. T. (2013). Cast saw noise does not reach occupational hazard levels. *Journal of Pediatric Orthopedics*, *33*(5), 580–584. https://doi.org/10.1097/BPO.0b013e318288b5e4

Puddy, A. C., Sunkin, J. A., Aden, J. K., Walick, K. S., & Hsu, J. R. (2014). Cast saw burns: Evaluation of simple techniques for reducing the risk of thermal injury. *Journal of Pediatric Orthopedics*, *34*(8), e63–e66. https://doi.org/10.1097/BPO.0000000000000274

Schlechter, J. A., Avik, A. L., & DeMello, S. (2017). Is there a role for a child life specialist during orthopedic cast room procedures? A prospective-randomized assessment. *Journal of Pediatric Orthopedics B*, *26*(6), 575–579. https://doi.org/10.1097/BPB.0000000000000310

Stryker, H. H. (1945). *Plaster cast cutter* (U.S. Patent No. US2427580A). https://patents.google.com/patent/US2427580A/en

Wilkins, K. E. (2005). Principles of fracture remodeling in children. *Injury*, *36*(Suppl. 1), A3–A11. https://doi.org/10.1016/j.injury.2004.12.007

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