

Radiation Protection to Surgeons' Hands with a Novel Radiation Attenuating Lotion



Smiresh Shah, M.D.

Kevin Chen, M.D.

Alfonso Mejia, M.D.

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Clinical Relevance

Orthopaedic surgeons are frequently at risk to excessive radiation exposure when performing fluoroscopy guided procedures. They choose not to use radiation protective gloves because of reduced dexterity and tactile sensation. This radiation attenuating cream may provide a new and better option for reducing their dose exposure by as much as 80%.

Introduction

Orthopaedic surgeons frequently exposing their hands and fingers to radiation with the use of fluoroscopy during procedures. An NIH study on fluoroscopically guided procedures spanning the past four decades revealed high exposure to clinicians' hands and underscored the need to reduce occupational radiation doses. The maximum annual limit to hands is 50 rem. This can be reached in 30 minutes of exposure to direct C-arm radiation, depending on X-ray intensity. Current radiation attenuating gloves lower the surgeon's dexterity and tactile sensation. This paper is the first report of the attenuation characteristics of a novel radiation attenuating lotion, that can be applied in a manner similar to sun-block lotion. The results indicate that this lotion effectively reduces radiation exposure and does not affect dexterity and sensation.



Image is for illustration only.

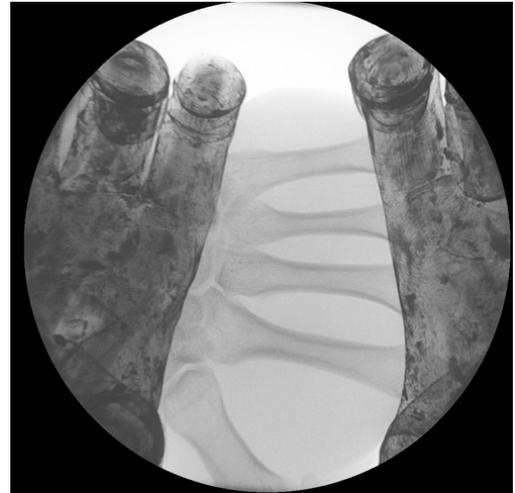


Methods

The lotion consists of an aqueous organic carrier and 75 weight % of bismuth oxide (Bi_2O_3) ceramic powder (Alfa Aesar, 99.99%). The organic carrier comprises lubricants, humectants and surfactants such as glycerin, glycol stearate and polyethylene glycol stearate, and emulsifiers such as glyceryl stearate. The ceramic powder was blended to make a lotion with a creamy texture qualitatively similar to hand lotions. Biocompatibility of the lotion and its constituent ceramic powder ingredient was assessed using ISO 10993 protocols.

Technical Summary

A standard C-arm fluoroscope was used to image cadaveric hands on a hand table, simulating an operative field configuration. Dosimeters measured direct radiation and scatter for 300 seconds at 53 kilovolts. The specific kilovolts used were calculated from the average of five cadaveric hands with the fluoroscope on an automatic setting. Dosimeters were implanted subcutaneously on the ipsilateral side or superficially on the contralateral side of each hand. Each configuration had five controls and five specimens with the attenuating lotion placed topically on the side nearest the source of radiation.



Results

Measured radiation exposure at the subcutaneous level and the contralateral side of the hand demonstrated that the lotion provided 81.5% and 63.7% attenuation (p-values of 0.00000006 and 0.0002) compared to bare cadaver hands. Measured scatter indicated no significant difference in radiation levels (p-values of 0.09 and 0.07).

Conclusion

This novel topical radiation attenuating lotion showed significant reduction in radiation exposure to hands. There was also no significant scatter, which is a key difference from previous glove designs for radiation protection. Use of this lotion may allow up to 5 times more radiation exposure before safety thresholds are reached.

Orthopaedic surgeons from the study group evaluated the texture and consistency of the product and concluded there was no impairment in tactile sensation. The lotion consists of a radio-contrast agent bismuth oxide and common ingredients found in hand lotions all of which were tested for safety, biocompatibility, skin irritation, skin sensitization, cytotoxicity, and acute and chronic systemic toxicities using well-established US FDA recognized standard ISO 10993 protocols. This lotion provides surgeons with a new and better option for radiation protection for their hands that can be applied in a sterile fashion prior to wearing surgical gloves and easily be washed off with soap and water.