

AN ALTERNATIVE APPROACH TO BONE PREPARATION FROM EMBALMED HUMAN CADAVERS

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Abstract

Background: Teaching anatomy in a scenario of setting up of new Medical Colleges is a challenging task owing to the unavailability of appropriate quantity of bones in the Medical Institutes in India. A method of bone procurement was explored in a tertiary care Institute from North India to be self-sustainable and reasonably quick to generate sufficient number of bones for Anatomy teaching. **Materials and Methods:** The present study was conducted at a tertiary care centre from North India in January 2023 and February 2023. Bones were taken from embalmed human cadaver and a bleaching powder and hydrogen peroxide method was used for bone procurement. The bones recovered using the technique were then air dried slowly for 2-3 weeks and then painted with a non resinated oil. **Results:** Fifty-one bones were procured in 14 working days with well-preserved morphological features. These included male pelvis (n=1), male sacrum (n=1), cranial vault (n=6), tibia (n=3), femur (n=4), fibula (n=2), scapula (n=1), humerus (n=1), radius (n=1), thoracic vertebra (n=5), lumbar vertebra (n=2), ribs (n=8), talus bone (n=1), navicular (n=1), cuboid (n=1), medial cuneiform (n=1), lateral cuneiform (n=1), intermediate cuneiform (n=1), metatarsal (n=5) and phalanges (n=5). **Conclusion:** This method was cost effective, easy to perform and time saving method and useful for making good quality bones for anatomical studies.

INTRODUCTION

Inculcating a thorough understanding of the Human Anatomy lays the very foundation of learning modern medicine for a medical graduate.^[1,2] Osteology teaching is essential from the perspectives of anatomy curriculum to train the future Indian Medical Graduates as well as in Forensic Sciences owing to its medico legal significance.^[3-5] In an attempt to cater to the healthcare needs of the rising population of the country and to balance out the availability of the doctors in rural areas as well as urban areas to improve the doctor patient ratio, the Government has been creating new medical colleges/ institutes and/ or increasing the MBBS seats in existing colleges.^[6,7]

Teaching anatomy in such scenario is a challenging task owing to the unavailability of appropriate

quantity of bones in the Medical Institutes in India.^[8] The procurement of bones commercially from the market are filled with a myriad of challenges such as i) prohibitive cost of a single set of bones (roughly rupees six to seven lacs on an average) in a developing country like India; ii) legal issues to discourage procurement and selling of bones by unauthorized vendors; iii) original bones not being available in the market due to Government policies considering the potential of human exploitation and other legal and ethical challenges; iv) artificial bones (made of plaster of Paris or resin) lacking the accurate anatomical features such as many foramina etc.^[8,9]

Therefore, many Institutes resort to the practice of bone procurement using some classical methods such as the burial method.^[10] There are other methods documented in the literature such as plastination,^[11] detergent,^[12] baking soda (sodium bicarbonate) and entomological action.^[4]

maceration with potassium hydroxide.^[3], antiformalin.^[13] and bleaching agent.^[8] The burial method is considered to be the best method for obtaining bones but it is tedious and time consuming besides requirement of a safe burial ground that needs adequate space. Many Institutes lack such space.^[14] thereby warranting the need for exploration of alternate methods of bone procurement. Institutes having a body donation programme can benefit from having sufficient number of bodies for dissection. The dissected parts from such bodies can be used for the procurement of bones.^[15] A method of bone procurement was explored in a tertiary care Institute from North India because of the above discussed factors. This in house technique was hypothesized to be self-sustainable and reasonably quick to generate sufficient number of bones for Anatomy teaching.

MATERIALS AND METHODS

The present study was conducted on formalin fixed, old specimen and dissected human cadaveric parts in the department of Anatomy at a tertiary care centre from North India in January 2023 and February 2023. The study was conducted after obtaining due ethical clearance from the Institute Ethics Committee (IEC). Long bones and other bones from embalmed human cadavers were taken in this study that included femur, tibia, fibula and foot bones from lower limb specimens, pelvis, sacrum, cranial vault, scapula, ribs, vertebra and ribs from specimens from a male cadaver. An upper limb specimen was obtained to procure humerus, radius and ulna. The method for bone procurement were as follows.^[14,15]

The dissected disposable cadaver part was immersed in tap water for 48 hours and then freed of soft tissue by scraping it off the bones. After thorough scraping, the bones were immersed in a solution of tap water and bleaching agent (sodium hypochlorite) in the ratio of 10:1 for 24 hours. Bleaching agent was used to degrease of bones and soften the tissue still attached to the bones after scraping. After 24 hours of immersion in the bleaching agent, the bones were removed from the solution and scraped again to remove any tissue attached to the bone. Some bones were brushed using a tooth brush to give them a clean, tissue free look.

Further, bones were immersed in 6% hydrogen peroxide solution for 24 hours. The hydrogen peroxide solution was used to bleach the bone (which helps in bone whitening) and give them a neat/ clean look. The bones were then air dried (slow drying) for two to three weeks depending upon the weather conditions and the season. The air drying helped remove the moisture from the bones since moisture makes the bone softer and, therefore, is detrimental to the bone durability. After drying, the bones were painted with a non resinated oil to provide durability and make them free from

infestation with pests. Finally, the bones were polished and were made ready for use during the demonstration classes.

RESULTS

A total of 51 bones were procured using this method during the study period (Fig. 1). The bones procured included male pelvis (n=1), male sacrum (n=1), cranial vault (n=6), tibia (n=3), femur (n=4), fibula (n=2), scapula (n=1), humerus (n=1), radius (n=1), thoracic vertebra (n=5), lumbar vertebra (n=2), ribs (n=8), talus bone (n=1), navicular (n=1), cuboid (n=1), medial cuneiform (n=1), lateral cuneiform (n=1), intermediate cuneiform (n=1), metatarsal (n=5) and phalanges (n=5).

The bones that were easiest to recover with the least amount of time and effort taken for procurement were the dense, long bones such as femur, humerus, radius, tibia and fibula. Small bones such as vertebra and foot bones were procured successfully but were more time and labour intensive to recover from the tissues. Pelvis, sacrum and cranial vaults were recovered were recovered with a slightly more laborious work. The most challenging task of bone recovery using this method was to recover scapula and ribs as half of these bones (scapula [n=1]; ribs [n=8]) became soft and lost their strength leading to loss of morphological features, thus, rendering them non usable for teaching methods.

A total of 13 bones could not be recovered from this method. These included ribs (n=8), vertebra (n=2), scapula (n=1), fibula (n=1) and ulna (n=1). While the scapula and ribs could not be recovered due to the above mentioned reasons, vertebra (n=2), fibula (n=1) and ulna (n=1) suffered damage to the morphological features due to technical error in handling the specimens.





DISCUSSION

Bones are always needed in medical institutes for teaching osteology in anatomy. The most common methods of procuring bones are the boiling method and the burial method but these two methods have their own limitations. On one hand the burial method requires long duration of time along with large space for burial and on other hand boiling method requires special big utensils for boiling along with properly ventilated space to deal with unpleasant odour of boiling bones. Aggarwal et al.^[15] in her study observed that 1:2 ratio of H₂O₂ and water yields better cleaning results for bones which were procured from 1-2 year old buried cadaver. In our study, we obtained bones from formalin fixed discarded cadaver parts. These bones are then cleaned by scrapping gently. The clean bones are then immersed in bleaching powder followed by treating with 6% H₂O₂. The bones procured by this trial method were of good quality. Also the time required in this process was lesser compared to other popular methods although it needs more men power.

Modi et al.^[16] have procured bone using boiling method along with usage of detergent also they have followed burial technique which requires long time for bone extraction thus our trial method proved to be less cumbersome and time efficient also our trial method came out to be more economical as compare to other methods.

Nayyar et al.^[8] have used different cleaning technique where they have extracted bones from cadaver by gross cutting and scraping. The scraped bones are then boiled in water for 2-3 hours. These boiled bones are then treated with KOH and common salt and left for 2 hours for softening of the remaining attached tissues, muscles & ligaments. By using a scalpel the remaining structures were removed from the bones and the bones were bleached with 30% H₂O₂. The bones are then left for drying. This method proved to be successful in procuring all types of bones of the body like skull bone, long bone, short bone etc. Our trial method had a limitation that it is not very successful in

procuring skull bones because of the presence of numerous foramina within the skull bone.

The bone procurement procedure proved useful in this tried method. It resulted in processing of original redundant bones into useable, clean bones with well-defined morphological features. It was a very simple procedure where no extra technical training was required. Also the chemicals and instruments used in this procedure were very basic and cheaply available. It was very cost effective and less time consuming where process where one can turn old formalin fixed specimen which are no more in use now turn into useful bone which could be used in medical institutions. The result of bone procurement were in good in case of new specimens which were in formalin for a long duration had resulted in weakening of bones. Thus, to get better results, use of fresh preserved specimen is recommended, such as 10-12 days old formalin fixed specimen.

The study has a few limitations. Firstly, this was a small study and a larger study is warranted to establish the effectiveness of bone procurement of various types of bones, especially the ones that could not be recovered optimally (approx. 50% bones rendered non usable) using the bleaching method such as scapula and ribs. Secondly, only one concentration of bleach was used and there could be a better concentration of bleach that could be more effective in bone recovery. Thus, a larger study is again required in which bones can be treated with a varying concentration of bleach to establish the best possible concentration for such technique.

CONCLUSION

This trial method was cost effective, time saving method and useful for making good quality bones for anatomical studies. Bones procured from this method have well preserved morphological features which are absent in artificial bones. This method being easy to perform can help medical institutes in procuring bones from the dissected cadavers at a minimal cost.

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