Research Article

Practicing Auricular Carving by Different Materials to Optimize the Results in Auricular Reconstruction

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Abstract
Introduction: Reconstruction of the ear is one of the most challenging problems facing a reconstructive surgeon as it demands precise technique combined with artistic creativity. (Sargent, 2017). **Aim of the study:** The aim of this study is to introduce a material that is convenient for training on auricular carving. **Materials& Methods:** This prospective, experimental study was carried out using two different materials for training on auricular carving: Synthetic Foam that is used for thermal insulation and bovine cartilage. 40 sculptures in total were done, 20 of each material. The sculptures were done sequentially staring with the foam material. Sculptures were divided in 8 groups according to chronological order. **Results:** Total scores of the last group of foam carvings were way better than the first group of bovine cartilage carvings**. Discussion:** Foam material isn't enough for training on auricular carving as it doesn't resemble the consistency of the human cartilages. **Recommendation:** based on the current study we recommend that every plastic surgeon should have a basic training on auricular carving.
Keywords: Auricular carving, Ear reconstruction, Frimin, Nagata, Autogenous cartilage graft.

Introduction
Ear deformities can be congenital or develop after traumatic events such as burns, accidents, bites, or accidental amputation by sharp elements (Silva et al., 2011).

The use of autogenous rib cartilage is the gold standard for auricular reconstruction. (Alnujaim and Alnujaim, 2017) creating the ear framework for total auricular reconstruction is technically challenging procedure. For novice surgeons it becomes difficult and time consuming. (Chen et al., 2004)

Materials & Methods
This prospective, experimental study was carried out using two different materials for training on auricular carving: Synthetic Foam that is used for thermal insulation and bovine cartilage. The study was conducted in a skill-lab at Minia& Kasr Al-Ainy University Hospitals in the period from November 2018 to May 2019. 40 sculptures in total were done, 20 of each material. The sculptures were done sequentially staring with the foam material. Sculptures were divided in 8 groups according to their chronological order.

These sculptures were subjected to the following:
Subjective assessment by a panel composed of 6 personnel; 3 of them were experienced with auricula carving and the other 3 weren't experienced with auricular carving. The assessment included these items: helix, antihelix, tragus-antitragus complex, overall similarity to the intact auricle. A total score was then calculated for each sculpture.

The panel Means for every sculpture was generated for the experienced category and non-experienced category.
Comparison between the results of Foam and Bovine cartilage carvings were done. *P* value was 0.66

Comparison between the results of the 8 groups were done. Carving group no. 1 had a mean rank of 6 while carving group no. 8 had a mean rank of 35.2

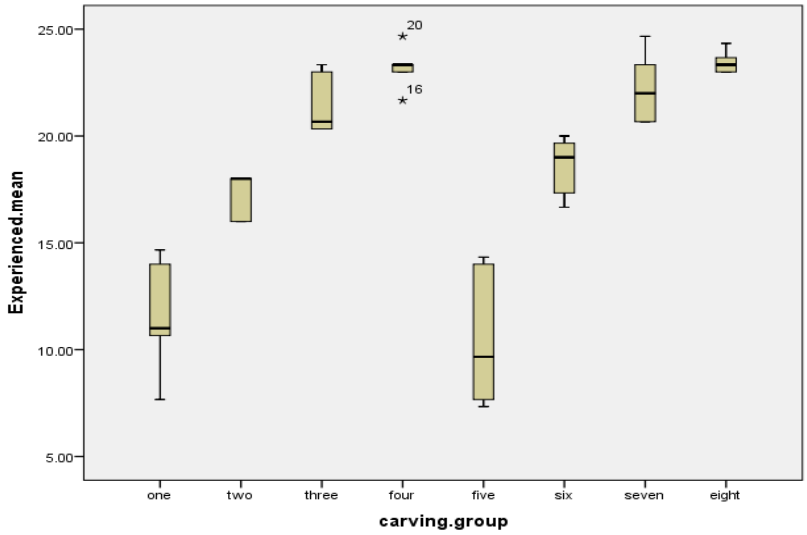

Figure 1 : Whisker and Box plot showing differences between 8 carving groups in Experienced category. It is obvious that there is no difference between group one and group five or group four and group eight but there is a difference between group 1 and group 8 , group 4 and group 5 , group 1 and group 4, group 4 and group 8.

Table 1: comparison between the results of the foam and bovine cartilage carvings

	Material	Mean Rank	*p* value
Non experienced mean	Foam	19.70	
	B.Cartilage	21.30	
	Total		*0.665*
Experienced mean	Foam	19.78	
	B.Cartilage	21.23	
	Total		*0.694*

Learning curves were generated, steady increase of the total score was noticed with a sudden drop on starting to use the bovine cartilage material.

There was strong positive correlation between the carving number and total score of the sculpture with *p* value of 0.001.

Discussion

In the present study two materials were used for auricular carving training, Synthetic foam (that is used for heat insulation, it was prepared and cut in 1 cm thickness) and bovine scapular cartilage. Twenty sculptures of each material were carved, using the foam and bovine cartilage sequentially.

Synthetic foam Analogue has been used by Firmin (Firmin and Marchac, 2011**)** as a valid material for training on auricular carving.

Firmin stated that the material used to learn sculpting the auricle is not an important part of the training process at all but the most important factors in training are to correctly

analyze the results and to observe the simulated appearance of the sculpture under the skin.(Firmin et al., 2016a) This can be done using the Firmin's trainer which was used in our study.

Bovine cartilage has been adopted by (Agrawal, 2015) and (Shin and Hong, 2013)

Bovine scapular cartilage was adopted by Argawal 2015 and it was used for training postgraduate students during a workshop. At the end of their workshop, all of the trainees felt that the consistency, flexibility, and movement of the knife were almost like that of human costal cartilage.

Regarding the results of the present study, the last group of the foam carvings had excellent assessment with a mean of (32.6), while the first group of bovine cartilage had less results with a mean of (4.8) although the carvings were done sequentially, indicating that the foam isn't sufficient alone as a training method.

Meanwhile, the learning curve of the bovine cartilage has been better with much more rapid improvement of the results indicating that the foam carvings have helped a lot. The last group of sculptures using bovine cartilage had a mean of (33.6).

Conclusion & Recommendations

Training on auricular carving would improve the surgeon's skills and their management regarding the available amount of cartilages and it would decrease the time consumed intra-operatively in the process of carving. Every plastic surgeon should have a basic training on auricular carving to understand the three-dimensional shape of the auricle and the basic carving steps.

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