Archives of Clinical & Experimental Surgery

Original Article

Arch Clin Exp Surg 2018;7:24-28

doi:10.5455/aces.20170227101620

eJManager OPEN ACCESS

Using walnut shell in the microdrilling training model

Cengiz Cokluk

ABSTRACT

Aims: The modeling of the surgical steps with creating a suitable laboratory models is critically important issue in the successful gaining of microneurosurgical practice. In this experimental study, a laboratory-training model was created for microneurosurgical drilling of delicate and thin cranial base bones using walnut shell in the repetitive repeating of experimental microsurgical training technique.

Materials and Methods: All steps of this study were performed under the operating microscope. Twenty-five walnut shells were used for this experimental feasibility study. The difficulty and suitability of the model were evaluated in terms of the usability in the training of microneurosurgical microdrilling. Difficulty of the procedure was divided into three degrees (very easy, easy, and difficult). The objective criterion for the evaluation of the difficulty of the procedure was the protection of the interior organic material during the procedure. The suitability of the procedure was also evaluated within three groups, bad, good, and perfect.

Results: In three (12%) walnut shells, the microdrilling was evaluated as difficult. The microdrilling procedures of the twelve (48%) walnut shells were evaluated as easy procedure. Microdrilling procedure of the remaining ten (40%) of the walnut shells was evaluated as very easy. The suitability of the model was evaluated as bad in two (8%) of the walnut shells. The suitability was found as good in 17 (68%) of the walnut shells. In microdrilling of the remaining six (24%) of the walnut shells, the suitability of the model was evaluated as perfect.

Conclusion: Microsurgical drilling of the walnut shells without any interior organic injury is accepted as the indication of the successful surgical microdrilling process. Consolidation of the surgical practice in a laboratory setting, grasping, and using of microsurgical instruments can be repeated several times in this model. We believe that this model will contribute to the practical training of microneurosurgery.

Key words: *Microneurosurgery, training of microsurgery, microdrilling, walnut shell*

Introduction

Microsurgical drilling of thin and delicate bones is a specific part of microneurosurgery. The neuroanatomical location of cranial base structures including basal cerebral arteries, hypophysis, cranial nerves, and brain stem makes the surgical approach to the cranial base unique in microneurosurgery [1-5]. Specific microneurosurgical techniques should be repetitively trained in laboratory on the appropriate models. Proper using of the operative microscope, holding, and grasping of the microneurosurgical instruments, proper microsurgical technique of the opening of the arachnoid membranes,

Author affiliations : *Department of Neurosurgery, Ondokuzmayis University, Medical Faculty, Samsun, Turkey*
Correspondence : *Cengiz Cokluk, MD, Department of Neurosurgery, Ondokuzmayis University, Medical Faculty, Samsun, Turkey*
e-mail: cengizcokluk@yahoo.com
Received / Accepted : *December 18, 2016 / February 10, 2017*

safe and delicate neurovascular dissection, and careful and proper microdrilling of the cranial base bones are some steps that should be repetitively trained on the appropriate experimental models in the training laboratory until the gaining of safe surgical technique [1,6-9]. Spending of time in experimental microsurgical laboratory to practice on some kind of microsurgical models such as dissection and suturing of the rat external carotid artery, dissection and evaluation of the abdominal vena cava of rats, suturing of the plastic glove materials by using microforceps under the operating microscope, and drilling and dissection of some cadaveric bone materials are essential in improving and gaining advanced microneurosurgical practical techniques [1,5-9].

The removing of the bony structures located over the critical, significant, and delicate structures such as hypophysis, internal carotid artery, brain stem, and cranial nerves is necessary during the intervention of some kind of operations such as intranasal transsphenoidal hypophysis surgery, presigmoid translabyrinthine approach, and anterior clinoidectomy [2]. Briefly, intradural and/or extradural removing of the thin and delicate bony structures overlying some significant and critical neural and vascular structures needs advanced microsurgical microdrilling techniques before performing operations. In this experimental study, a laboratory-training model was created for microneurosurgical drilling of delicate and thin cranial base bones using walnut shell in the repetitive repeating of experimental microsurgical training technique.

In this experimental modeling study, the utility of the removing of a part of the walnut shell was evaluated using high-speed microdrill in the creation of simple microdrilling training model in the area of basic microneurosurgical training. On the other hand, the feasibility of using this model in the microdrilling of the cranial base bones such as sella floor in clinical microsurgical practice was also evaluated. Experimental findings, difficulties, practical methods, and suggestions were discussed in the light of the literature.

Materials and Methods

This study was performed in Microneurosurgery Laboratory of Neurosurgery Department, Faculty of Medicine. Thirty-five dried walnut shells were used in this experimental feasibility study. Aluminum wire mesh tray was used for stabilization of the walnut shells under the operating surgical microscope (Zeiss Surgical Microscope, Germany). Rubber elastic bands were used for fixing the walnut shells in the aluminum mesh tray (Figure 1). The rectangle plastic ruler with circular openings over its large flat surface was used for more stabilization and fixation of the eggshell under the surgical microscope before starting the procedure (Figure 1). Using pencil, the operating area was marked before starting the microsurgical drilling procedure. Using high-speed microsurgical drill (Midas Rex® Legend® Electric System, USA), the lateral surface of the walnut shells was microdrilled with proper attachment (Small Bore Variable Exposure Attachment) and tools (5 mm ball and 5 mm ball diamond) of the Midas Rex® Legend® Electric System for opening of the burr holes (Figure 2). Interior membranous dissection and separation were performed using microforceps, microdissector, and microhook (Figure 3).

Difficulty and suitability of the procedure were analyzed in the evaluation of the model. Difficulty of the procedure was divided into three degrees (very easy, easy, and difficult) according to the description of the performer [1]. The main objective criterion for the difficulty of the procedure was described as the protection of the interior organic materials along performing the procedure. The suitability of the procedure was also evaluated within three groups as bad, good, and perfect. The criterion for taking into account the suitability of the procedure was as follows: being easy to find, the resemblances to the cranial base bones, the suitability for drilling procedure, and short preparation period before experiment.

Results

In three (12%) walnut shells, the microdrilling was evaluated as difficult. The microdrilling procedures of the twelve (48%) walnut shells were evaluated as easy. The microdrilling of the remaining ten (40%) of the walnut shells was evaluated as very easy. The suitability of the model was evaluated as bad in two (8%) of the walnut shells. The suitability was found as good in 17 (68%) of the walnut shells. In microdrilling procedures of the remaining six (24%) of the walnut shells, the suitability of the model was evaluated as perfect. Microsurgical drilling of the superior, inferior, and lateral

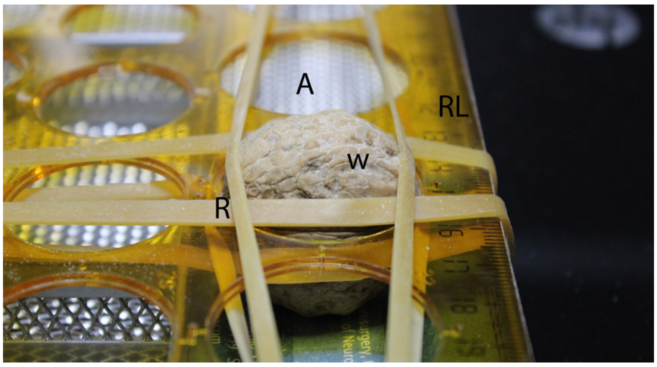

Figure 1. This figure shows the details of the experiment (**A:** aluminum mesh tray, **W:** walnut shell, **R:** rubber band, and **Rl:** ruler).

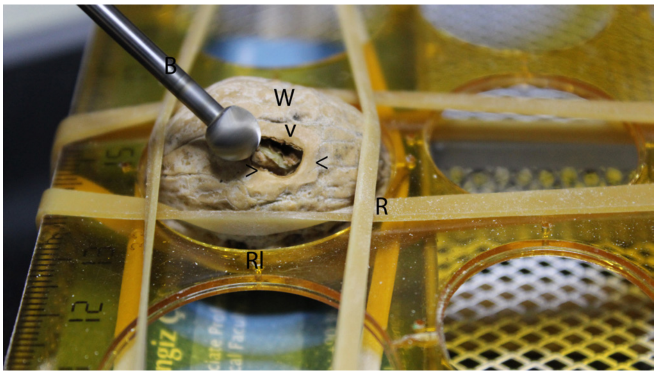

Figure 2. The microdrilling of the eggshell is shown in Figure 2 (**W:** walnut shell, **R:** rubber band, **Rl:** ruler, the arrows show the microdrilling area, and **B:** ball tool).

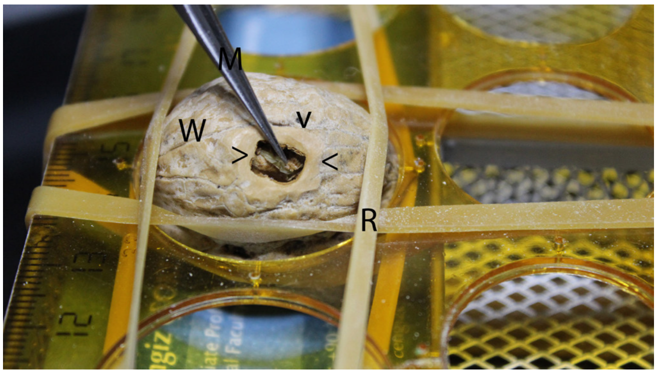

Figure 3. This figure shows the dissection and separation of the walnut membrane (**W:** walnut shell, **R:** rubber band, **M:** microbayonet, and the arrows show the dissection area).

wall of the walnut shell and enabling repetitive drilling are indications of the suitability of the material. Microsurgical drilling of the walnut shells without any membranous injury located just on the inner surface of the outer walnut shell is an indication of the successful surgical microdrilling process. Microforceps, microhook, and microdissector may also be used in the identification, separation, and dissection of the inner membranous structure. This step is similar to the dissection and separation of the dura mater. Microdrill tips with different features and sizes may be used in this model. The rotation speed of the microdrill and the effect of rotation speed on the microdrilling process may clearly be evaluated in this experimental model.

Discussion

Intradural and/or extradural removing of the thin and delicate bony structures overlying some significant and critical neural and vascular structures needs advanced microsurgical microdrilling techniques. Generating a simple and suitable model is significantly important in the training of delicate and thin bone drilling. The aim of this experimental study was to create a laboratory-training model for the repetitive repeating of microneurosurgical drilling of cranial base bones using walnut shell in the experimental microsurgical training. The results of this study showed that 88% of the walnut shell drilling procedures were evaluated as easy and very easy in terms of the technical manner. On the other hand, 68% of the walnut shells drilling procedures were found as a suitable model in the training of microdrilling process.

A safe microneurosurgical approach needs advanced knowledge on regional microneurosurgical neuroanatomy [1]. On the other hand, technical and practical using of microsurgical instruments such as high-speed drill and its attachments and tools, microbayonets, microhooks, and microdissectors, is also another significant issue in the training of microneurosurgery. The using of these instruments with appropriate microsurgical technique is crucially important [1]. For this reason, generating an appropriate model of microneurosurgical training is necessary in the technical and practical gaining of safe surgical techniques. The specific surgical techniques should also be repeated several times on appropriate models to successfully maintain and terminate microsurgical interventions [1].

Before a real operation performed on human beings, understanding of abilities of some sophisticated devices to be used in the microneurosurgical intervention such as high-speed drill and its attachments and tools is extremely necessary. The electrically powered high-speed drilling systems have different types of attachments. In addition, the different variety of tools can be used during the operation. These instruments can be repetitively tried on this appropriate model in the practical and technical understanding of the capabilities of the attachments and specific ball and ball-diamond tools. In addition, it is required for one to develop his/her own abilities [1,5-9]. The results of this study verified that using walnut shell microdrilling model has advantages in gaining practical microdrilling techniques and technical understanding of the capabilities of the attachments and specific ball and ball-diamond tools of the high-speed drill.

An appropriate and successful model should have some similarities to the represented models in order to be a suitable model. On the other hand, the easily obtainable and cheap properties are other significant topics. Other important issues are the short and easy preparation period of the model before using under the surgical microscope. Repetitive operations on the model in various ways can be considered as an advantage. When taking into consideration the ethical issues, living models, in addition to the above-mentioned disadvantages, compromise some problematic limitations in experimental practice. Some advantages can be seen when we evaluate the walnut shells in the light of the parameters detailed above. Walnut shell has some similar features in comparison with the floor of the cranial base bones in terms of size, thickness, and shape. The walnut shell is an inexpensive material that can be obtained easily because the walnut is a food source consumed through nutrition. The walnut is not a living model; there is no need for local ethical committee permission. So there are no ethical restrictions in this model in comparison with living models. When we think of all of these features together, the walnut shell should be regarded as a suitable model in the experimental microneurosurgical microdrilling of the floor of the cranial base bone-training model.

It is also important to recognize the specific surgical instruments used in this proposed model and gain some practice by trying them out in various ways. Electrically powered high-speed microdrill is one of these instruments. Allowing microdrills to be used in this experimental model with different tips and types makes the person more familiar with this device. The process of reducing and increasing the turning speed of the microdrill and observation of the events to occur during this process can be considered as the other purpose of this practice. The use of the microhook in the dissection of the inner membrane from the rigid outer shell can also be practiced. Using the microdissector in the separation and removing very thin and delicate remnant of drilled shell can be tried for practicing.

Conclusion

Removing the thin and delicate bone structure of the cranial base by using microdrilling is one of the most important steps of the surgical approach. Before starting the surgical intervention performed on living subjects, this process should be practiced several times on practical training models. In this experimental study, walnut shells are proposed as a practical training model in the microsurgical drilling of thin cranial base bones. Consolidation of the surgical practice in a laboratory setting, grasping, and using of microsurgical instruments can be repeated several times in this model. We believe that this model will contribute to the practical training of microneurosurgery.

Conflict of interest statement

The authors have no conflicts of interest to declare.

References

1. Cokluk C, Aydin K. Maintaining microneurosurgical ability via staying active in microneurosurgery. Minim Invasive Neurosurg 2007;50:324-7.
2. Kiran NAS, Furtado SV, Hedge AS. How I do it: Anterior clinoidectomy and optic canal unroofing for microneurosurgical management of ophthalmic segment aneurysms. Acta Neurochir 2013;155:1025-9.
3. Hincke MT, Nys Y, Gautron J, Mann K, Navarro ABR, McKee MD. The eggshell: structure, composition and mineralization. Front Biosci (Landmark Ed) 2012;17:1266-80.
4. Nakano T, Ikawa NI, Ozimek L. Chemical composition of chicken eggshell and shell membranes. Poult Sci 2003;82:510-4.
5. Yadav YR, Parihar V, Ratre S, Kher Y, Iqbal M. Microneurosurgical Skills Training. J Neurol Surg A Cent Eur Neurosurg 2016;77:146-54.
6. Altunrende ME, Hamamcioglu MK, Hıcdonmez T, Akcakaya MO, Bırgılı B, Cobanoglu S. Microsurgical training model for residents to approach to the orbit and the optic nerve in fresh cadaveric sheep cranium. J Neurosci Rural Pract 2014;5:151-4.

7. Belykh E, Byvaltsev V. Off-the-job microsurgical training on dry models: Siberian experience. World Neurosurg 2014;82:20-4.
8. Turan Suslu H, Ceylan D, Tatarlı N, Hıcdonmez T, Seker A, Bayrı Y, et al. Laboratory training in the retrosigmoid approach using cadaveric silicone injected cow brain. Br J Neurosurg 2013;27:812-4.
9. Spetzger U, von Schilling A, Brombach T, Winkler G. Training models for vascular microneurosurgery. Acta Neurochir Suppl 2011;112:115-9.