

*Original Research***Indigenous Corrosion Cast Preparation of Biological Organs using Denture Material****N. Venumadhav^{*}, D. Pramod Kumar², N. Ramya¹ and N. Rajendranath**

Department of Veterinary Anatomy, College of Veterinary Science, Rajendranagar, Hyderabad, Telangana, INDIA

¹Department of Livestock Production Management²Department of Veterinary Anatomy, College of Veterinary Science, Korutla, Jagtial, Telangana, INDIA***Corresponding author:** venumadhav.nayini@gmail.com

Rec. Date:	Oct 10, 2019 15:35
Accept Date:	Dec 08, 2019 11:42
DOI	10.5455/ijlr.20191010033523

Abstract

Cost effective indigenous 'Corrosion cast' method was devised to prepare 3D details of biological organs. Thirty paired fresh kidneys of 10 each from three species i.e., cattle, goat and pig were utilized to study the details of renal collecting system (RCS) and blood vessels. Organs were flushed with warm normal saline solution through their ureters after which a cold cure self-polymerizing acrylic powder and solution mixed in a 1:2 ratio along with few drops of desired colored dye was injected. Specimens were effectively polymerized at room temperature, followed by their immersion in 75% HCl till corrosion process was completed. Later the specimens were dissected to study the branching pattern of ureter in cattle and renal pelvis in pig and goat. Specimens were kept in museum without any preservatives for long time and used for teaching the anatomy of vessels, ducts and cavities of organs. This technique reduces the biological risk present in formalin fixed organs.

Key words: Acrylic Powder and Solution, Corrosion Cast, Kidney, Renal Collecting System**How to cite:** Venumadhav, N., Kumar, D., Ramya, N., & Rajendranath, N. (2019). Indigenous Corrosion Cast Preparation of Biological Organs using Denture Material. International Journal of Livestock Research, 9(12), 169-174. doi: 10.5455/ijlr.20191010033523**Introduction**

Corrosion cast preparation technique is used to study the three-dimensional structures of various parts of biological organs. Variety of casting materials were utilized to obtain 3D endo casts, of which polyester resin was most commonly used (Nerantzis *et al.*, 1978). Polyester resin injection was used to prepare cast of all cardiac vessels in human hearts (Nerantzis *et al.*, 1978), to study branching pattern of renal collecting system (RCS) in kidney of dog (Pereira-Sampaio *et al.*, 2009), sheep (Buys-Goncalves *et al.*, 2016) and pig (Gomez *et al.*, 2017) and RCS and renal artery distribution pattern in kidneys of cattle (Pereira-Sampaio *et*

al., 2010). Esteban *et al.* (2017) cited corrosion cast technique by using different types of polymers in different organs and species, *viz.* acrylic, epoxy resin, polyester resin and RTV silicone. They used preservatives like water to prevent any fractures since the corrosion casts prepared by using above casting materials were fragile.

Different solutions were used for corrosion process namely, concentrated HCl (Nerantzis *et al.*, 1978; Pereira-Sampaio *et al.*, 2009; Pereira-Sampaio *et al.*, 2010; Buys-Goncalves *et al.*, 2016), 15% KOH (Gomez *et al.*, 2017) and concentrated NaOH (Esteban *et al.*, 2017) to get 3D endo casts of vessels or ducts of injected organs. These authors also added a catalyst like methyl ethyl peroxide to the casting material before injection into organs to obtain good quality 3D endo casts, which required specialized equipment's like positive pressure pumps for injection.

Materials and Methods

Corrosion cast preparation was as per the protocol of Buys-Goncalves *et al.* (2016) with slight modification. Instead of polyester resin in the technique, cost effective denture material was used in this study, which gave desirable result. This technique was performed on 10 pairs each of fresh kidneys from cattle, goat and pig resulting in an excellent cast ready in 24 hrs. Kidneys of cattle were used to prepare casts of renal collecting system (RCS) including ureter and major and minor calices and also the distribution pattern of renal artery. Kidneys of goat and pig were used to obtain casts of branching pattern of renal pelvis with its recesses in the former and calices in the latter. The procedure involved the following three steps:

Preparation of the Denture Material (A)

A thick colorless liquid prepared by adding one part of cold cure self-polymerizing acrylic powder and two parts of cold cure solution, both of which are available in separate packets (Fig. 1). Coloured dyes were added to (A) to get desired color for demarcating anatomical details of blood vessels, ducts and cavities, *viz.* red dye for arteries, blue dye for vein, yellow for ducts, green or orange dyes for cavities.



Fig.1: DPI-RR Cold cure acrylic powder 110 g and liquid 110 ml bottles.

Specimen Preparation

Fresh specimen is a prerequisite to prepare an ideal cast instead of routine formalin fixed specimens. Blood clots and debris were removed from the specimen by washing under running tap water. Vessels and ducts or cavities of organs were flushed with warm normal saline solution to clear their lumen. This procedure caused water absorption by specimen which became slightly edematous. This was resolved by gentle squeezing of the whole organs and cavities.

Injection of Cast Material

With the help of disposable syringes attached to plastic cannulae, the casting material was injected into the vessels as per color code (Fig. 2). The injection is continued until a resistance is felt, avoiding leakage from the injection site as it would be polymerised resulting in a false picture. The procedure should take place within 10 minutes, to avoid early polymerization of the media before injection.

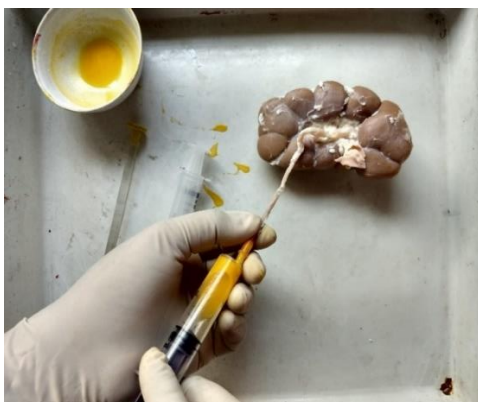


Fig. 2: Injection of casting material into ureter of kidney in cattle



Fig. 3: Corrosion process of injected pig kidneys

The vessels or ducts were clamped and ligated following the injection. The injected specimens were kept at room temperature for about 3-5hrs to allow the solution to polymerize in each vessel uniformly. After solidification the specimens were immersed in a large glass beaker containing 75% HCl which gradually

corroded the surrounding tissue (Fig. 3). Once the corrosion process was complete it was washed gently and with a fine forceps debris if any, was removed to get an intact well-formed cast.

Results and Discussion

This technique was simple, rapid and economical (cost of both denture material @ 285 INR only) and did not require any specialized equipment for injecting the casting material. Whereas epoxy resin, polyester resins and other casting materials required positive pressure pumps (Nerantzis *et al.*, 1978 and Esteban *et al.*, 2017). Time taken for corrosion depended on the size of the specimen and type of tissue as shown in Table 1.

Table 1: Maximum time recommended for injection, hardening of cast material inside the organ and corrosion process

S. No.	Species and Organ	Maximum recommended injection time (min)		Hardening time (hrs)	Corrosion time (hrs)
		in RCS	in Renal Artery		
1	Cattle kidney	6 min	8min	5-8 hrs	8-10 hrs
2	Goat kidney	3 min	-	4-5 hrs	5-6 hrs
3	Pig kidney	8 min	-	6-8 hrs	10-12 hrs

Shrinkage and crumbling of specimens were unnoticeable after storage time at room temperature without any preservatives (Fig. 4, 5, 6). The findings were in partial agreement with Nerantzis *et al.* (1978) and Esteban *et al.* (2017). Use of cold cure self-polymerizing acrylic material gave good results in this study similar to other polymers used, viz. polyester resins (Nerantzis *et al.*, 1978; Pereira-Sampaio *et al.*, 2009; Pereira-Sampaio *et al.*, 2010; Buys-Goncalves *et al.*, 2016 and Gomez *et al.*, 2017), silicone and epoxy resin (Esteban *et al.*, 2017). No catalyst was needed for effective polymerization in this study. The results were equally good and the specimens were well stored since three years.

In the present investigation, 75% HCl was used in the corrosion process to clear the tissue effectively similar to other chemicals like 15% KOH (Gomez *et al.*, 2017) and NaOH (Esteban *et al.*, 2017). In the corrosion process concentrated HCl was also used earlier (Nerantzis *et al.*, 1978; Pereira-Sampaio *et al.*, 2009; Pereira-Sampaio *et al.*, 2010; Buys-Goncalves *et al.*, 2016). Biological casts obtained by this method in this study revealed very clear 3D endo casts of RCS and renal artery distribution pattern in cattle (Fig. 4), the RCS of kidneys in pig (Fig. 5) and the renal pelvis, crest and recesses on dorsal and ventral surface of the renal pelvis in goats (Fig. 6).

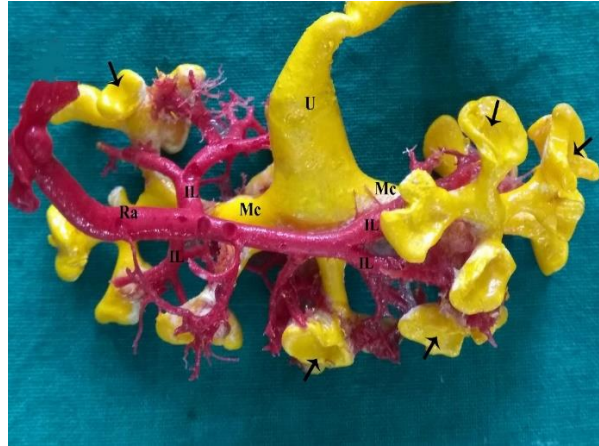


Fig. 4: 3D corrosion cast of cattle renal collecting system. (U – Ureter; Mc – Major calyx → Minor calyx; Ra – Renal artery; IL – Interlobar artery



Fig. 5: Corrosion cast of left and right pig RCS showing major (Mc) and minor calices (→). U – Ureter
*Renal pelvis



Fig. 6: Corrosion cast of right goat kidney RCS showing U- shaped recesses. (U – ureter * - renal pelvis
→ renal crest

Conclusion

This corrosion cast technique using cold cure self-polymerizing acrylic material (denture material) was cost effective, easily reproducible and consumed less time. Casts formed by this method were relatively firm and gave an ideal 3D picture of the vascular or duct pattern of the specimen. Standard casts prepared by other polymerizing agents were handled meticulously and stored in containers, since they became dry and brittle. The self-polymerizing acrylic casts prepared in this study were firm and did not require any container for storage, so as to be displayed in museums and used effectively in teaching methodology.

Acknowledgement

The authors are thankful to the P.V Narsimha Rao Telangana Veterinary University to carry out the present work.

References

1. Buys-Goncalves, G. F., De Souza, D. B., Sampaio, F. J. B. and Pereira-Sampaio, M. A. (2016). Anatomical relationship between the kidney collecting system and the intrarenal arteries in the sheep: contribution for a new urological model. *The Anatomical Record*, 299(4), 405-411.
2. Esteban, R. R. J., Lopez McCormick, J. S., Martinez Prieto, D. R. and Hernandez Restrepo, J. D. (2017). Corrosion Casting, a Known Technique for the Study and Teaching of Vascular and Duct Structure in Anatomy. *International Journal of Morphology*, 35(3).
3. Gomez, F. A., Ballesteros, L. E. and Estupinan, H. Y. (2017). Anatomical study of the renal excretory system in pigs. A review of its characteristics as compared to its human counterpart. *Folia Morphologica*, 76(2), 262-268.
4. Nerantzis, C., Antonakis, E. and Avgoustakis, D. (1978). A new corrosion casting technique. *The Anatomical Record*, 191(3), 321-325.
5. Pereira-Sampaio, M. A., Marques-Sampaio, B. P., Henry, R. W., Favorito, L. A. and Sampaio, F. J. (2009). The dog kidney as experimental model in endourology: anatomic contribution. *Journal of Endourology*, 23(6), 989-993.
6. Pereira-Sampaio, M., JS Bagetti Filho, H., S. Carvalho, F., JB Sampaio, F. and W. Henry, R. (2010). A proposed new classification for the renal collecting system of cattle. *American Journal of Veterinary Research*, 71(11), 1264-1269.