The Tissue Reaction To certain Retrograde Filling materials Employed In Endodontic Practice – An Experimental Study

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INTRODUCTION

- In modern dentistry, the basic philosophy is conservation, preservation and restoration of the complements of the dental arches.
- Maintaining the integrity of the natural dentition is an essential prerequisite for a fully functional & esthetic masticatory apparatus.Endodontic therapy has played an important role in achieving this goal by enabling teeth to be conserved & retained without constituting a danger either to the health of the supporting structures or to the general health of the patient.

- Periapical surgery, in the clinical practice of Endodontic is often indicated to correct failures or limitations of conventional Endodontic treatment. It is widely accepted that apical resection followed by retrograde placement of a root filling is the treatment of choice in such instances.

- In the past, the clinician had not placed sufficient importance on the biological assay of the materials employed in endodontics.Dental materials and devices are now being considered more like drugs and therefore have to meet specifications such as biocompatibility.A document to this effect,recommending the standard practices for the biological evaluation of dental materials,was formulated in 1972 for test methodology and requirements,that ensure use of safe as well as effective materials in dentistry.

- Currently there are three recommended tests, viz. a primary generalized toxicity screening test, a secondary local toxicity screening test and a usage test38. Among the secondary tests, implantation of the material into the subcutaneous tissue of small animals is considered a suitable method for evaluation of the biocompatibility of endodontic materials[26].
- Retrograde filling materials, that are irritating in nature if injudiciously allowed to come in contact with viable periapical tissue, then pain associated with inflammation and necrosis my result17. This chemical injury will lower the regenerative power of the tissues in the area with delayed repair and questionable prognosis.

- In addition to biocompatibility, the retrograde filling material should fulfill some other requirements such as non-irritancy, dimensional stability and non-absorbability. Various materials viz. silver amalgam, guttapercha, Cavit, Polycarboxylate cement, IRM, Composite resin, gold foil, glass ionomer cement, etc. have been introduced over the years for the purpose of retrograde filling, as none of the available obturating materials fulfills the criteria laid down.

- Hermetic seal is mandatory for successful endodontic therapy, in order to eliminate all portals of entry of exudate, bacteria and their toxins from the root canals into the adjacent periapical tissues. Inadequate hermetic seal of the root canal could be due to many causes such as solubility of the root canal filling material in periapical exudate, dimensional changes of filling materials, improper manipulation and poor obturation of the root canal.

- The commonly employed silver amalgam has certain disadvantages as a retrograde filling material15.
- Delayed expansion due to moisture contamination.
- Lack of seal, at least in the initial stages with the prepared root canal surface.
- Large gaps between the amalgam and prepared root canal walls.
- Biocorrosion, whereby an electrical current is created between tissue fluids and the alloy interface resulting in marginal deterioration.
- Argyria in the surrounding tissues.

- Unlike conventional methods of obturation where the material remains within the root canal, a retrograde filling material is immersed in the tissue fluids and remains in contact with the living cells. Since silver amalgam as retrograde filling material does not fulfill all the criteria, at least in the initial stages, zinc Polycarboxylate cement has been suggest as an alternative to amalgam for use in endodontic surgical procedures because of its adhesion to enamel and dentin. In addition, its mild irritant potentialities substantiates its utility as a retrograde filling material.

- Since Polycarboxylate cement has an inherent weakness of dissolving in the tissue fluids and with the increasing use of composite resin in dentistry in recent years, attempts have been made towards its application in endodontics as retrograde filling material. Due to paucity of studies on biocompatibility of composite resin, it was decided to study the tissue response of Polycarboxylate cement and compare it with that of chemically activated composite resin as retrograde filling material in the subcutaneous connective tissue of albino rats of wistar strain.

STATEMENT OF THE PROBLEM

- It is proposed to study the tissue reaction to two retrograde filling materials -

1. Poly carboxylate cement and
2. Composite resin (chemically activated, hybrid type).

RATIONALE OF THE STUDY :

1. To study the tissue reaction to zinc-poly-carboxylate cement as a retrograde filling material at various observation periods (Control Group).
2. To study the tissue reaction to chemically cured composite resin as a retrograde filling material at various observation periods (Study Group).
3. To compare the tissue reaction to zinc Polycarboxylate cement to that of chemically activated composite resin as retrograde filling material at various observation periods.

MATERIALS AND METHODS

- A sample of sixty four pellets of Polycarboxylate cement and composite resin (chemically activated, hybrid type) was selected to study their biocompatibilities as retrograde filling materials. These materials were implanted in sixteen, clinically healthy, adult, albino rats of wistar strain, weighing 200 gms to 250 gms each.(Figure)
- This species was chosen because of maintenance of uniformity in its genetic characteristics.
- The sixteen animals of this study were equally distributed into four groups i.e. four animals in each group, to study the tissue reaction at various intervals of observation periods :

1. After 3 days
2. After 10 days
3. After 20 days
4. After 30 days

Fig.1 - Showing adult albino rat on weighing scale.

PREPATION OF THE SPECIMEN

According to the manufacturers recommendations, cylindrical pellets of 2mm diameter and 2mm length were prepared aseptically from Ploycarboxylate cement (Harvard CC Carboxylate cement) and composite resin (Coltene Brilliant Hybrid Composite)

SURGICAL PROCEDURE:

An armamentarium comprising the following instruments (Fig.2) was autoclaved &kept ready for implantation for the pellets.

The medicaments used during the procedure were :

1) Anaesthetic ether for general anaesthesia.
2) Betadine (Antiseptic solution)
3) Inj.Paracetamol
4) Inj.Ampicillin
5) Soframycin ointment

Fig.2 - Showing armamentarium.

Anesthesia:

Inhalation ether with the help of a glass beaker containing cotton wool soaked with ether.

Preparation of the part:

The dorsal surface of the rat was shaved from the interscapular to the pelvic regions. The area was scrubbed thoroughly with beta dine and the animal was transferred to the surgical board.

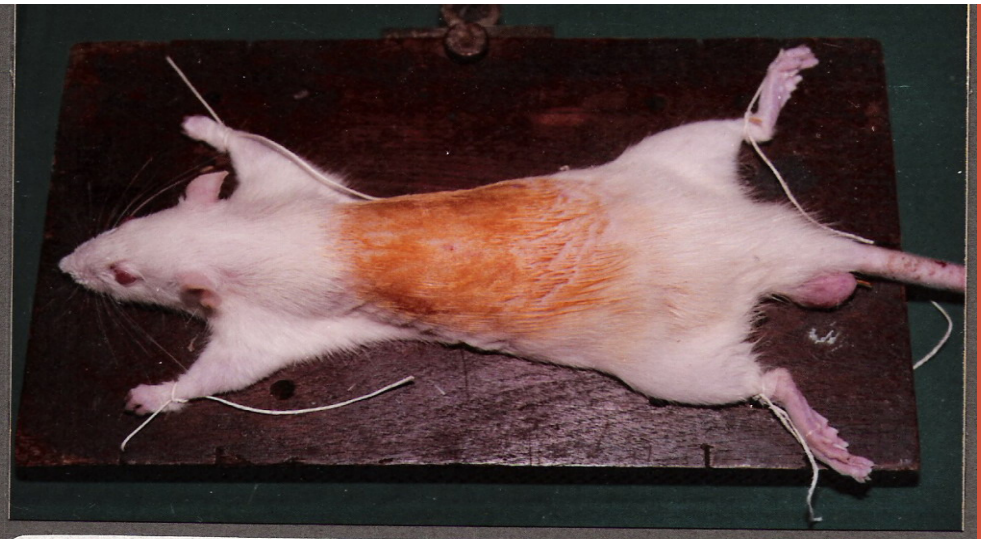


Fig.4 - Showing scrubbed surgical site.

➢ *Implantation of the pellets:*

A vertical incision of half a centimeter length was made at 4 sites for insertion of the prepared pellets.

Through each incision, a space of about 2 cm was tunneled by blunt dissection in the subcutaneous tissue with a small haemostat.Care was taken to minimize surgical trauma to the surrounding tissues during operative procedure

The prepared pellets of polycarboxylate cement were implanted in the prepared spaces on the right side & pellets of composite resin were implanted on the left side of the animal body. Fig

The incisions were sutured with sterile 4-o black,braided,surgical silk suture material and soframycin ointment was applied over the surgical site.

The animal was transferred to a separate cage for post-op. recovery & was closely monitored for tempreture,pulse & respiratory rate till it completely recovered from anesthesia.

- Post-Operative care:

a) Inj.Ampicillin

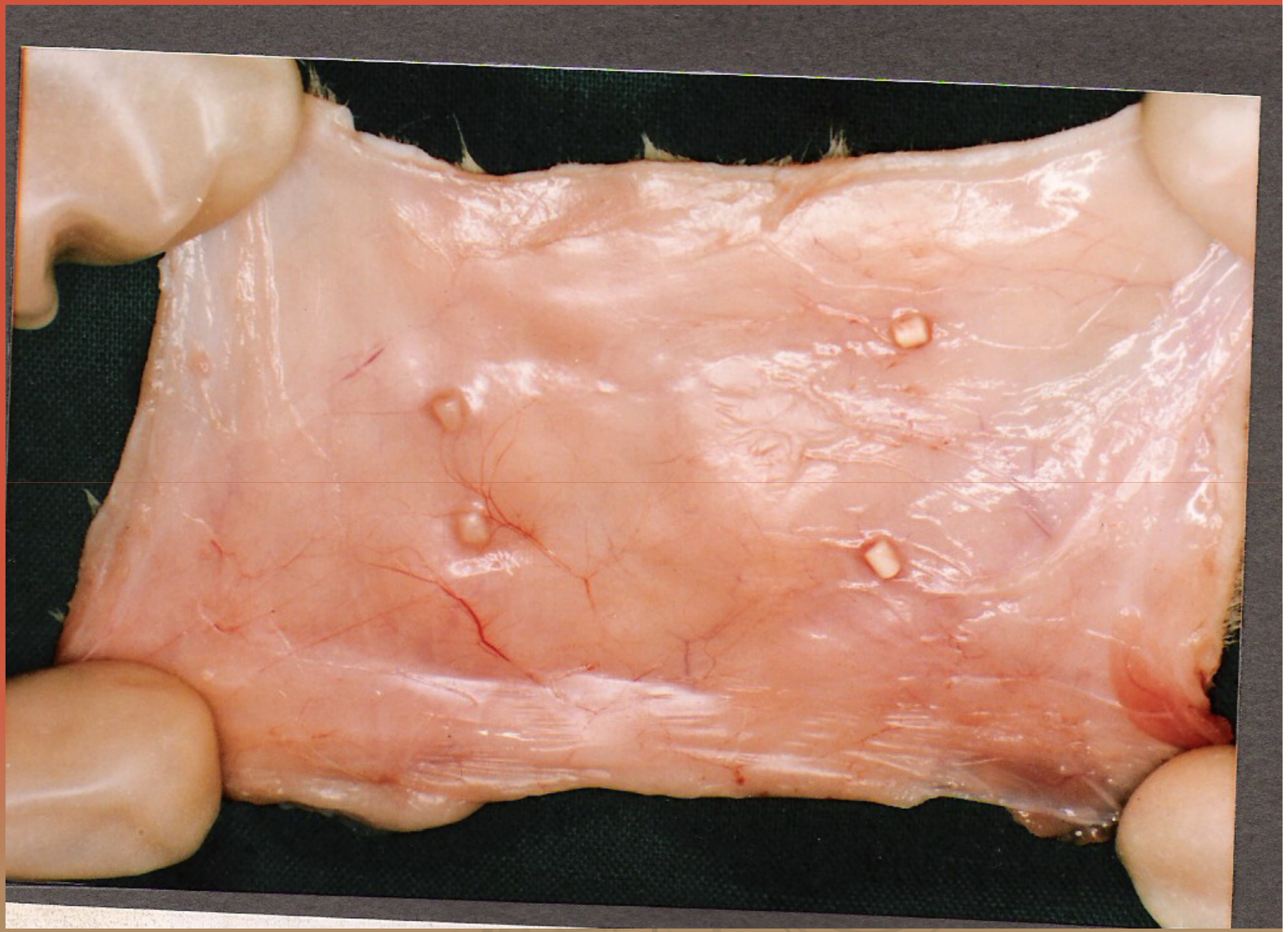
b) Inj.Paracetamol

c) Soframycin ointment

The healing was normal & uneventful with no complications. The habits, activities and body weight of the animals were closely observed & the sutures were removed on the 7th day.

- Excision of the tissue:

At the end of the observation period, the animal was sacrificed with an overdose of ether and about 1cm of tissue surrounding the pellets was excised. Fig. and transferred to fixing solution (10% neutral, buffered formalin) for a period of 48 hours.



- *Preparation of the specimen for histological study :*

The implanted pellet was removed from the tissue & 6 micro m. thickness sections of the tissue were prepared and stained with haematoxylin and eosin for histologic study.

TABLE NO.1 - SHOWING NUMBER OF SAMPLES FOR TISSUE RESPONSE AFTER THREE DAYS

TOTAL NUMBER OF SAMPLES STUDIED : POLYCARBOXYLATE : 8

COMPOSITE RESIN : 8

MATERIALS STUDIED FOR BIOCOMPATIBILITY	INFLAMMATORY RESPONSE			HEALING RESPONSE		FOREIGN BODY GIANT CELL RESPONSE		
	MILD	MODERATE	SEVERE	GRANULATION TISSUE	FIBROSIS	NONE	MILD	MODERATE
POLYCARBOXYLATE CEMENT	6	2	0	8	0	8	0	0
COMPOSITE RESIN	0	1	7	8	0	8	0	0

TABLE NO.2 - SHOWING NUMBER OF SAMPLES FOR TISSUE RESPONSE AFTER TEN DAYS

TOTAL NUMBER OF SAMPLES STUDIED : POLYCARBOXYLATE : 8

COMPOSITE RESIN : 8

MATERIALS STUDIED FOR BIOCOMPATIBILITY	INFLAMMATORY RESPONSE			HEALING RESPONSE		FOREIGN BODY GIANT CELL RESPONSE		
	MILD	MODERATE	SEVERE	GRANULATION TISSUE	FIBROSIS	NONE	MILD	MODERATE
POLYCARBOXYLATE CEMENT	8	0	0	7	6	0	0	0
COMPOSITE RESIN	6	2	0	8	3	0	6	2

- Observation tables :

TABLE NO.3 - SHOWING NUMBER OF SAMPLES FOR TISSUE RESPONSE AFTER TWENTY DAYS

TOTAL NUMBER OF SAMPLES STUDIED : POLYCARBOXYLATE : 8

COMPOSITE RESIN : 8

MATERIALS STUDIED FOR BIOCOMPATIBILITY	INFLAMMATORY RESPONSE			HEALING RESPONSE		FOREIGN BODY GIANT CELL RESPONSE		
	MILD	MODERATE	SEVERE	GRANULATION TISSUE	FIBROSIS	NONE	MILD	MODERATE
POLYCARBOXYLATE CEMENT	7	1	0	8	8	8	0	0
COMPOSITE RESIN	6	2	0	7	8	8	0	0

TABLE NO.4 - SHOWING NUMBER OF SAMPLES FOR TISSUE RESPONSE AFTER THIRTY DAYS

TOTAL NUMBER OF SAMPLES STUDIED : POLYCARBOXYLATE : 8

COMPOSITE RESIN : 8

MATERIALS STUDIED FOR BIOCOMPATIBILITY	INFLAMMATORY RESPONSE			HEALING RESPONSE		FOREIGN BODY GIANT CELL RESPONSE		
	MILD	MODERATE	SEVERE	GRANULATION TISSUE	FIBROSIS	NONE	MILD	MODERATE
POLYCARBOXYLATE CEMENT	0	0	0	0	8	8	0	0
COMPOSITE RESIN	8	0	0	6	8	8	0	0

Summary

- A sample of 64 pellets of polycarboxylate cement & chemically activated composite resin- retrograde filling materials, was used to study the tissue response in albino rats of Wister strain. These materials were implanted in the subcutaneous tissue of 16 adult albino rats, equally distributed into 4 groups for various observation periods i.e.3,10,20 and 30days.

Under G.A. using ether after preparation of the part,4 incisions were made and 2 pellets of each material were implanted below the skin and the wounds were sutured & post operatively the animals were observed. Healing was normal and uneventful. The animals were then sacrificed & the tissue spp.containing the pellets were obtained, fixed in formalin, dehydrated in graded ethyl alcohol, cleared in xylene,embedded in paraffin wax & bocks were prepared. Six micrometer thick sections were made & stained with haematoxylin and eosin. The stained sections were subjected to histological examination and the results were tabulated.

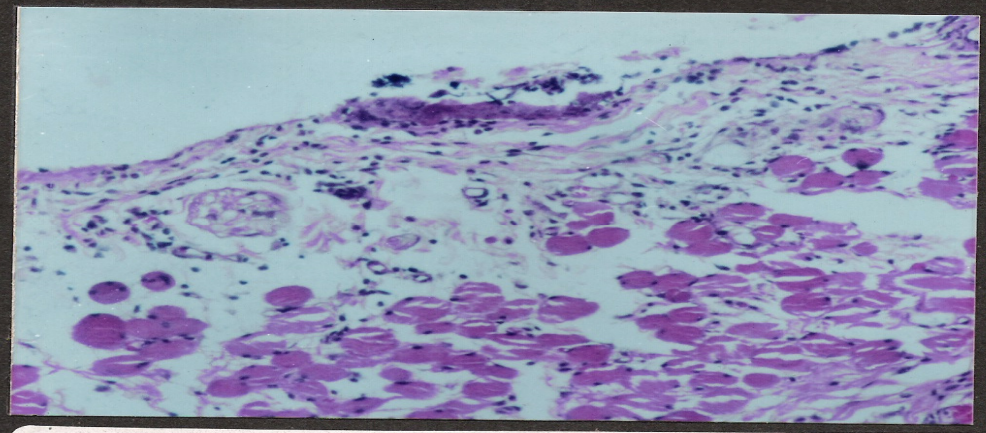


Fig.10 - Histological section showing tissue response to Polycarboxylate cement after three days H & E (10X).

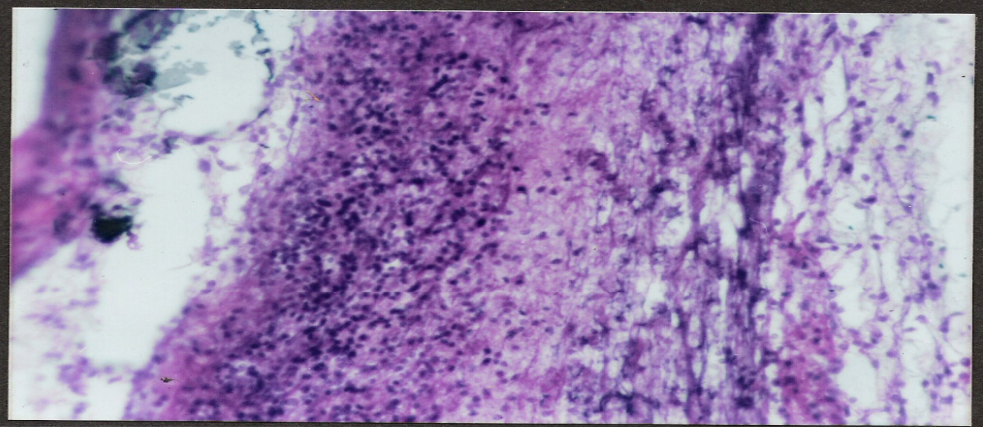


Fig.11 - Histological section showing tissue response to composite resin after three days H & E (10X).

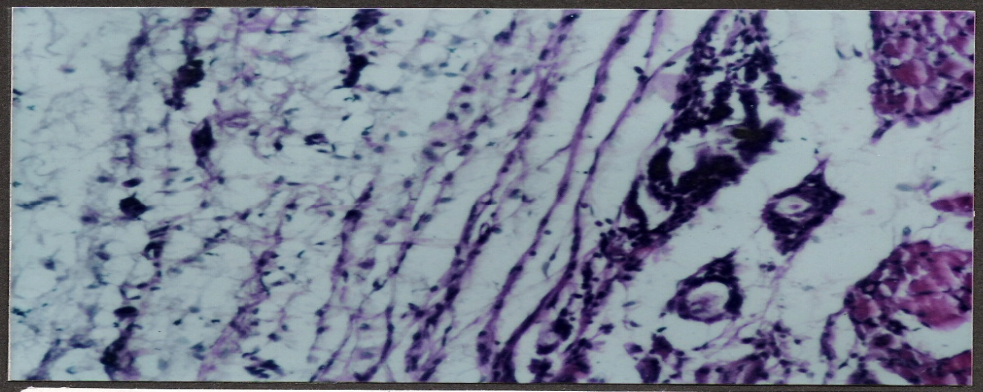


Fig.12 - Histological section showing tissue response to Polycarboxylate cement after ten days H & E, (10X).

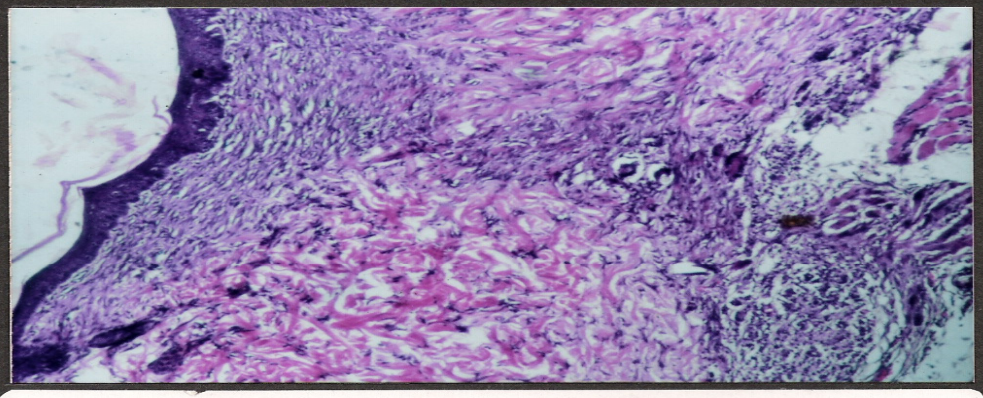


Fig.13 - Histological section showing tissue response to composite resin after ten days H & E, (10X).

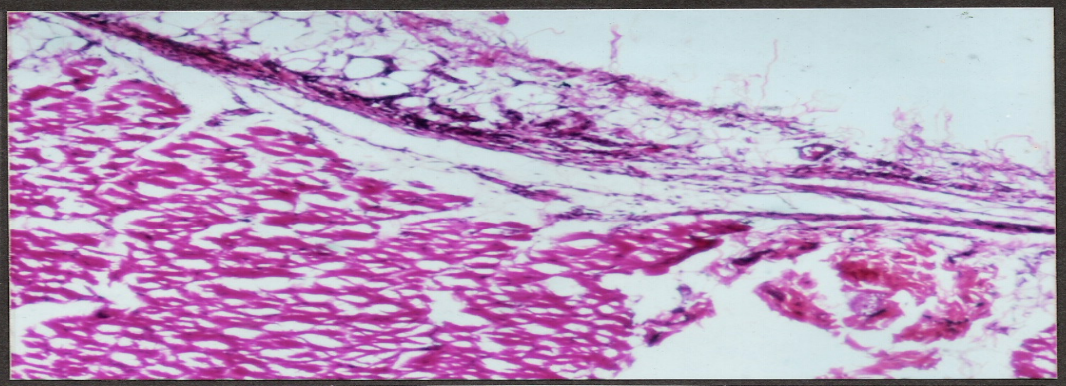


Fig.14 - Histological section showing tissue response to Polycarboxylate cement after twenty days H & E, (10X).

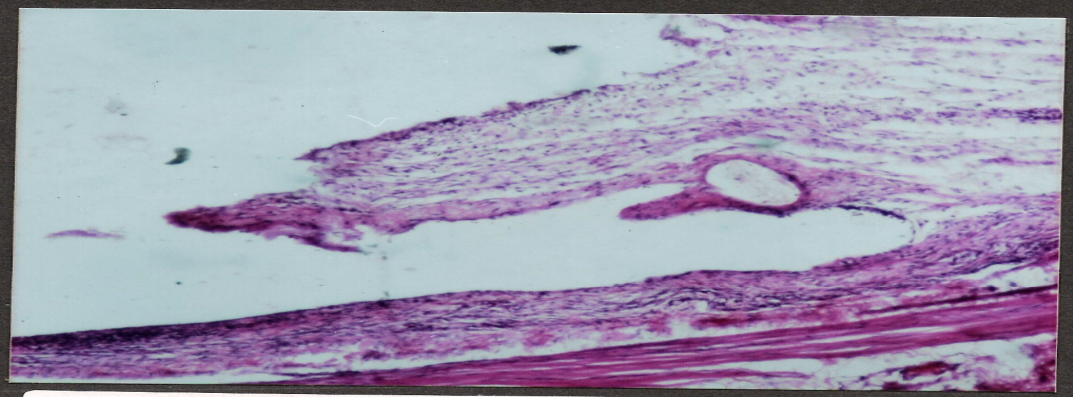


Fig.15 - Histological section showing tissue response to composite resin after twenty days H & E, (10X).

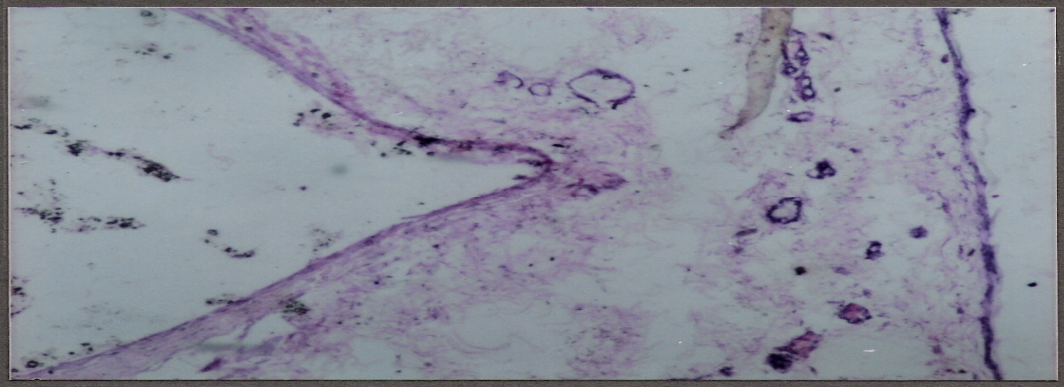


Fig.16 - Histological section showing tissue response to Polycarboxylate cement after thirty days H & E, (10X).

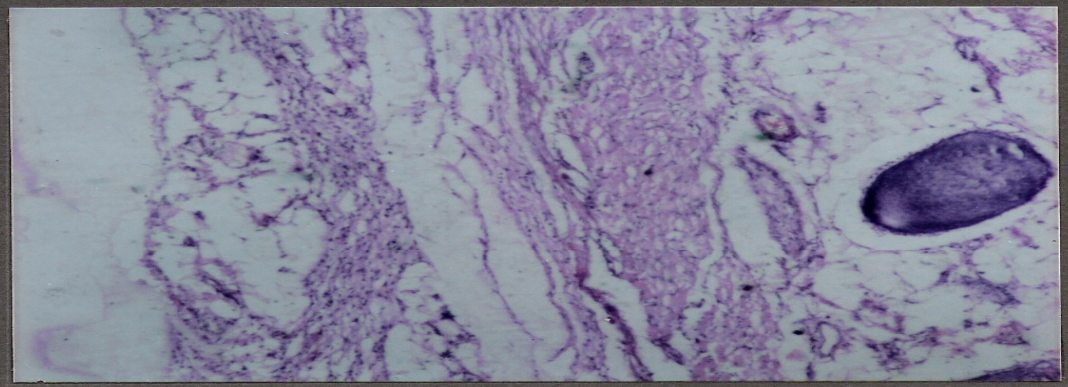


Fig.17 - Histological section showing tissue response to composite resin after thirty days H & E, (10X).

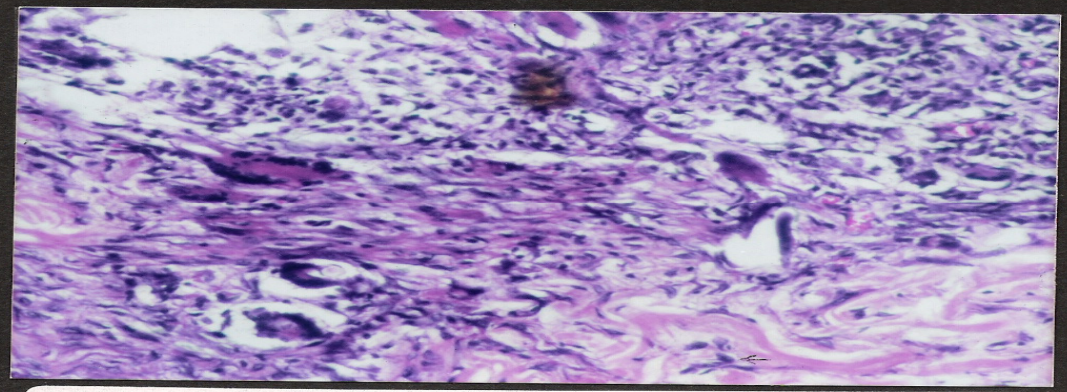


Fig.18 – Histological section showing Giant cells (20X).

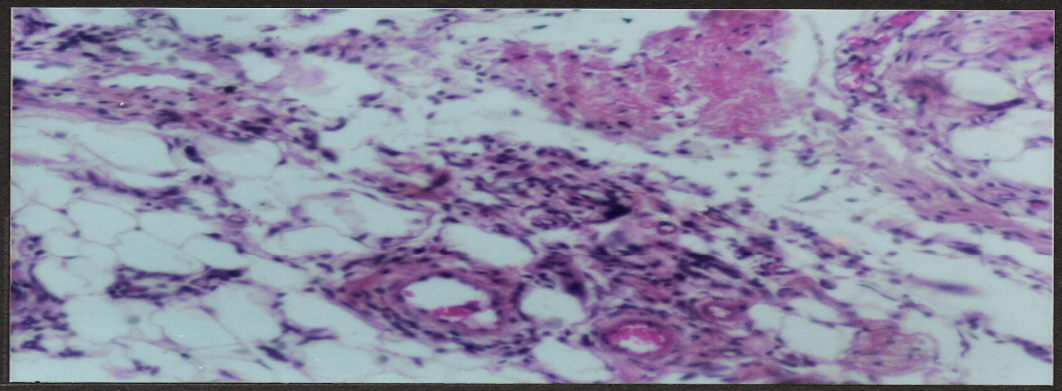


Fig.19 – Histological section showing Histiocytes and eosinophils (20X).

Conclusion

The tissue response for zinc polycarboxylate cement was favorable as it showed mild to moderate inflammatory reaction initially which gradually healed & formed fibrous capsule around the pellets. Healthy condition was restored at the end of the experiment.

The tissue response for composite resin showed moderate to severe inflammatory reaction initially which gradually reduced to mild reaction at the end of the experiment. presence of eosinophils after 10 days is suggestive of an allergic response of the tissue which subsided at the end of 30 days. Similarly an early mild foreign body giant cell response was detected at the end of 10 days which subsided at the end of the experiment.

Although the inflammatory response for zinc polycarboxylate cement was favourable,composite resin still showed mild inflammatory response at the end of the experiment.

At a glance, the inflammatory response was marginally less for polycarboxylate cement with faster and complete healing by fibrous capsule, suggestive of walking-off of the inflammatory process.Further,the presence of refractile material in foreign body granulomas-a foreign body cell reaction which was not seen with polycarboxylate cement was found in composite resin specimens after 10 days observation period.

THANK YOU

THE ONLY TRUE WISDOM IS IN KNOWING YOU KNOW NOTHING

SOCRATES