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COMPARISON OF FERRIC SULFATE AND GLUTERALDEHDYE AS A PULPOTOMY AGENT

L.G.VIJAYAALAKSHMI*

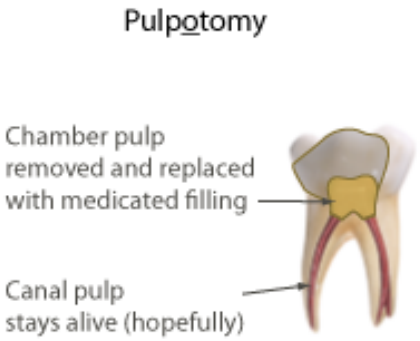
INTRODUCTION :

A major goal in pediatric dentistry is to maintain the primarydentition in an intact state until the permanent successors erupt. Pulpotomies help maintain arch integrity by allowing preservation of teeth that would otherwise be destined for extraction.Pulp therapy for the vital primary tooth has evolved over the past 20 years with the introduction of new pulp therapy medicaments and the return of old techniques.The main objective of pulp therapy in the primary dentition is to retain every primary tooth as a fully functional component in the dental arch to allow for proper mastication, phonation, swallowing, preservation of the space required for eruption of permanent teeth and prevention of detrimental psychological effects due to tooth loss[1,2].To fulfill this major goal, vital pulp therapy through pulpotomy, which refers to surgical removal of the entire coronal inflamed pulp leaving the vital radicular pulp intact within the canals, is the most widely accepted technique for treating primary teeth with irreversible inflammation affecting the pulp chamber.

The pulpotomy is still the most widely used treatment for the primary tooth where caries has closely approximated the pulp so that complete removal would expose the pulp [3] .The most commonly used pulpotomy pulp medicaments are formocresol, ferric sulfate, and mineral trioxide aggregate (MTA)[4].However, an old technique, indirect pulp therapy (IPT), also known as indirect pulp capping, has made a return as a viable alternative to pulpotomy in the same teeth indicated for a pulpotomy[5] .The formocresol pulpotomy technique is considered the most universally taught and preferred pulp therapy for primary teeth at the present timeand since it was introduced in 1904 by Buckleyit has undergone a lengthy evolution to

* FINAL YEAR BDS, GUIDE NAME:DR.DEEPA, DEPARTMENT OF PEDODONTICS, SAVEETHA DENTAL COLLEGE &HOSPITALS,CHENNAI-77.

shorten the application time and reduce the concentration of the agent used[6,7]. The technique has a long history of overall clinical success ranging from 55% to 98%, and many studies



have used variations of the technique, and defined success and failure using a variety of criteria[8-16] .Despite years of apparent successful use as a pulpotomy agent, formocresol has come under attack for the research and documentation in the literature which have shown formaldehyde to be toxic, mutagenic and carcinogenic[17-20] .The response to the controversy has been a quest for alternative agents and techniques. Currently, the technique receiving the most attentionis ferric sulfate and gluteraldehyde.

FERRIC SULFATE AS A PULPOTOMY AGENT :

Ferric sulphate ($Fe_2(SO_4)3$),is a chemical compound which is said to be the sulphate of trivalent iron. It is usually yellow, rhombic crystalline salt and soluble in water at room temperature. It is used in dyeing as a mordant and as a coagulant for industrial wastes. It is used as an astringent and styptic.Ferric sulfate (Fe2[SO4]3) as a 15.5% solution (AstringedentTM, Ultradent Products, Inc., Salt Lake City, UT), has been used commonly as a coagulative and hemostatic retraction agent for crown and bridge impressions and is slightly acidic.

The mechanism of action of ferric sulfate is still debated, but agglutination of blood proteins results from the reaction of blood with both the ferric and sulfate ion[21].The agglutinated protein forms plugs to occlude the capillary orifices.Thus, unlike traditional hemostatic agents, ferric sulfate affects hemostasis through a chemical reaction with blood[22].Ferric sulfate is proposed as a pulpotomy agent on the theory that its mechanism of controlling

hemorrhage might minimize the chances for inflammation and internal resorption believed by some investigators (Schroeder)to be associated with physiologic clot formation.Investigators have not explained how clotting itself could curtail these activities[23] .

Ranly proposes the possibility that the metalprotein clot at the surface of the pulp stumps may act as a barrier to the irritative components of the sub-base and in that capacity, functions solely in a passive manner[24]. Currently, an exact mechanism explaining why ferric sulfate would be expected to be superior to previous pulpotomy agents, such as formocresol, has yet to be provided. In fact, the technique is quite similar to performing ZOE pulpotomies. The human studies with ferric sulfate are limited in time and have small sample sizes. Additional long-term studies with increased sample sizes should be conducted before ferric sulfate can be recommended as a substitute for the "gold standard" formocresol technique. Several studies compared the clinical success of ferric sulfate with formocresol .

A retrospective study by Nikki L. Smith et al based on patients receiving ferric sulfate pulpotomies with a sub-base of zinc oxide eugenol in a clinical practice over a five year period revealed the success rates was found lower than those reported previously in the literature for ferric sulfate pulpotomies, but are comparable with those reported for 1:5 dilution, 5-minute formocresol pulpotomies[25] .A study by PAPAGIANNOULIS on clinical studies on FS as a pulpotomy medicament in primary teeth suggested that ferric sulphate be used, rather than formocresol, for pulpotomies of primary teeth as the latter has been blamed for systemic and local side effects on the developing successors[26.]

A clinical study of ferric sulfate as a pulpotomyagent in primary teeth by Ay-LuenFei, BD$, MSRichard D. Udin, DDSwere performed on 83 primary molars in 62 patients. Ferric sulfate/formocresol was placed on the pulpal stumps,and teeth were followed for 3,6,12 month periods.After the one year follow-up, 28 of 29 teeth treated with ferric sulfate (FS group)were considered successful and 21 of teeth treated with formocresol (FC group) were judged to be successful. The FS group demonstrated greater combined clinical and radiographic success than the FC group at the one-year recall ($P<0.05$). The combined overall success rate of the FS group was 96.6% and the FC group was 77.8%. [27]

GLUTERALDEHDYE AS A PULPOTOMYAGENT :

Glutaraldehyde for pulp fixationwas proposed by s-Gravenmade in 1975. Gluteraldehyde is a colourless solution that has a mild odour and a boiling point of 183°C to 187°C, is soluble in water and produces a mild acidity on contamination .This di-aldehyde has a limited shelf life and a cross-linking ability superior to that of formocresol. In recent years, glutaraldehyde has been proposed as an alternative to formocresol based on its superior fixative properties, self-limiting penetration, low antigenicity, low toxicity and elimination of cresol [28,29] .Glutaraldehyde produces rapid surface fixation . Narrow zone of eosinophillic stained and compressed fixed tissue is found beneath the area of application which blends with underlying normal pulp [29,30].

Hill reported minimal antimicrobial concentration of glutaraldehyde as 3.125%[31.] Ranly, Garcia Godoy in 1987 noted that increasing the concentration and longer time improves fixation and suggested the use of 4% Glutaraldehyde for 4 minutes or 8% Glutaraldehyde for 2 minutes[30]. Sandra Maria et al. suggested the use of 2 % for 5 minutes [32,33] . Presently, 2 % glutaraldehyde for 5 minutes is used for pulpotomy. Various studies report improved success rates .Garcia-Godoy reported that despite of high success rates the drawbacks in using glutaraldehyde includes the cost and inadequate fixation that leaves a deficient barrier susceptible for sub base irritation resulting in internal resorption [34.]

Researchers Vivek Kumar Adlakha, PreetikaChandna et al found the success rate was found to be 100% clinically and 80.33% radiographically in the hydroxyapatite crystals group and 100% clinically and radiographically in the glutaraldehyde group[35] because glutaraldehyde appears to produce tissue fixation without causing tissue necrosis at high concentrations. Although it depresses PMN adherence at intermediate concentrations, it does not seem to stimulate PMN adherence and cause inflammatory tissue damage at low concentrations.

ShashidharChandrashekhar, JyothiShashidharcompared the clinical and radiological effects of formocresol and glutaraldehyde pulpotomies in various exposed vital human primary molars.[36] The 2% glutaraldehyde compound was promising when compared to ferric sulfate and formocresol in an *in vivo* study. The only limitations of glutaraldehyde are instability due to short shelf-life and it has to be freshly prepared. In this study, the clinical and radiographic success of formocresol, glutaraldehyde and ferric sulfate were compared as a pulpotomy

medicament in primary molars at 3-month intervals over 1 year. Internal resorption was found in all the medicaments. Clinical success was higher than the radiological success[37]. Long-term (36 months) success rates of four different glutaraldehyde preparations (2%-buffered and unbuffered, 5%-buffered and unbuffered) as a pulpotomy agent in pulp exposed primary molars were evaluated. The 5% buffered solution group showed highest success rate, whereas 5% unbuffered solution showed the lowest[38.]

CONCLUSION:

Success of pulpotomy depends on various vital factors like case selection, clinical diagnosis, intraoperative diagnosis and most importantly the material used for the pulpotomy procedures so called "Ideal Pulpotomy material" is not yet been identified.Formocresol Pulpotomy enjoys very good clinical and radiographic success rates, and is still a popular pulpotomy material despite the concerns raised due to its toxicity, mutagenicity and carcinogenicity. Clinical studies report good success rates of Ferric sulfate 15.5% and gluteraldehyde as alternatives to FC. One of the major limitations of using MTA is its high cost and its use in pediatric dentistry practice can become almost prohibitive in some circumstances. Hence, FS can still be considered a valid and inexpensive solution for pulpotomies in primary teeth.

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