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RESEARCH ARTICLE

EFFECTIVENESS OF PULP REVASCULARIZATION VERSUS MTA APEXIFICATION IN TREATMENT OF NECROTIC IMMATURE TEETH: A SYSTEMATIC REVIEW.

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Key words:-
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Abstract

Background: Management of the immature non vital anterior tooth with apical pathosis represent several treatment challenges. Lack of apical closure complicates the root filling procedure and the attainment of an apical 'seal'**(Shah et al., 2008; Cehreli et al., 2011)**. The goal from pulp revascularization is to regenerate a pulp-dentine complex that restores functional properties of this tissue and allow continued root development for immature teeth **(Hargreaves et al., 2008).**

Objective: The aim of this systematic review was to evaluate and demonstrate comprehensive data about pulp revascularization and mineral trioxide aggregate apexification in treating necrotic immature teeth. **Method:** An extensive search was performed on PubMed, Cochrane Library, and EBSCO. The assessed primary outcome was resolution of clinical symptoms. The secondary outcome was root development. **Result**: Three articles of clinical trials met the inclusion criteria and were included. For patients who have necrotic immature permanent teeth, pulp revascularization is more effective in furthering root development of necrotic immature permanent teeth compared to MTA apexification

Introduction:-

Thin walls of radicular dentin and absence of apical constriction represent treatment challenges for necrotic immature teeth **(Al Ansary et al., 2009 and Mente et al., 2009).**

Traditionally, necrotic immature teeth were treated with calcium hydroxide apexification in order to induce formation of calcific barrier apically **Rafter (2005).**

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MTA® apexification capable of inducing artificial barrier apically like calcium hydroxide apexification with advantage of reducing appointments number and treatment time. But in same time two technique possess the same disadvantage where it doesn't allow continuous root development that lead to thin root wall susceptible to fracture **(Khetarpal et al., 2013).**

To overcome this problem disinfection of root canal system with antibiotic paste will create environment suitable for root maturation and apical closure in a recent approach called pulp revascularization **Huang (2009) and Hargreaves (2011).**

Objectives:-
To conduct a systematic review to assess the clinical efficacy of pulp revascularization and mineral trioxide aggregate (MTA) apexification in necrotic immature teeth in resolving clinical sign and symptom and promoting further root development.

PICO:-
P- → Necrotic immature permanent teeth
I-→ Pulp revascularization
C-→ MTA apexification
O-→ Resolution of clinical sign and symptom and root development

Research question:-
For patients who have necrotic immature permanent teeth, are pulp revascularization more effective than MTA apexification in resolving clinical sign and symptom and promoting further root development?

Search strategy:-
We searched the following electronic bibliographic databases: Pubmed, Cochrane Library, and EBSCO. Hand searching of the reference lists of identified articles was performed to identify other potentially relevant articles as shown in fig.1. Meticulous electronic search was carried out including terms linked to the intervention (Pulp revascularization, Pulp Regeneration, Pulp Revitalization, Maturogenesis, Regenerative endodontic treatment, Regenerative endodontic procedures, Regenerative endodontics, Regenerative root canal treatment), the control (MTA apexification, Mineral Trioxide Aggregate apexification, Apical seal, Apical plug, Apical barrier, One step apexification, One visit apexification, Single visit apexification) and the population (Immature, open apex, young permanent, incomplete root formation, underdeveloped root) & (Non vital, Necrotic, Infected, irreversible pulpitis, apical periodontitis, periapical abscess PubMed, Cochrane Library, and EBSCO, were demonstrated in figure (1).

Inclusion Criteria:-
Clinical studies that compare MTA apexification with pulp revascularization
Patient with necrotic immature permanent teeth
The teeth will be evaluated clinically and radiographically
Follow up at least for 6 months
Written in English

Exclusion criteria:-
Literature review
Case study or case series
Histological study
Animal study
Clinical studies without control group

Data Extraction:-
Initially, 106 articles were found from the electronic search: 78 from PubMed, 7 from Cochrane library and 21 from EBSCO. After disregarding 19 duplicated studies and adding another 1 article from hand-searching of reference section, 88 articles were left. 85 articles were discarded before full-text retrieval by title and abstract according to exclusion criteria. Full texts of 3 publications were retrieved and analyzed in detail.

Quality Assessment:-
The design and quality of each of the included studies were assessed, including whether a centered research question has been addressed, relevant key words have been used and also regarding the clarity and validity of the outcomes and results. (Table 1)

Results:-

Three studies were identified through the search, which are **Ding et al., 2009, Nagy et al., 2014 and Narang et al., 2015**. They were potentially eligible for full text analysis (figure 1); the 3 studies were included in the systematic review.

Characteristics of the included studies were represented in table 2 while table 3 is showing interpretation of the methodological steps performed in each study.

In the studies assessed, the number of treated teeth were 46. Age of treated patient range from 8-19 y and the main teeth evaluated were incisors (n = 29), followed by premolars (n=7) and no studies evaluated molars (n=0). One study didn't clarify type of teeth treated. The necessary first step for treating infected necrotic teeth is root canal disinfection. To do this, sodium hypochlorite (NaOCl) was used at concentrations ranging from 2.5–5.25%. This was followed by the placement of an antibiotic paste after minimum or no instrumentation. The time the drugs spent in the root canal ranged between one to four weeks, until no sign of infection was observed.

After the infection subsided, over instrumentation to induce bleeding into the canal was performed, followed by coronal sealing with MTA or glass ionomer in REG GROUP. While in APEX GROUP 3–4 mm of MTA placed as apical plug, rest of canal filled with thermoplasticized gutta-percha.

The most used restorative material was composite resin. Clinical and radiographic evaluation during the follow-up time that range from 15-18 months.

Resolution of clinical sign and symptoms, resolution of periapical radiolucency, increase in length and thickness of root, and sign of apical closure were reported.

The high success rate of revascularization technique described in table (4) suggests that it is a successful treatment modality for immature permanent teeth with necrotic pulp but due to presence of conflicting data regarding success rate clinically when compared with MTA apexification further studies is required to reach a clear evidence.

For patients who have necrotic immature permanent teeth, regenerative endodontic treatment are more effective in furthering root development of necrotic immature permanent teeth compared to MTA apexification as described in table (4). This has been best shown by clinical studies in which regenerative endodontic procedures yielded a more significant increase in root length, width and show apical closure of immature necrotic teeth compared with apexification procedure using MTA.

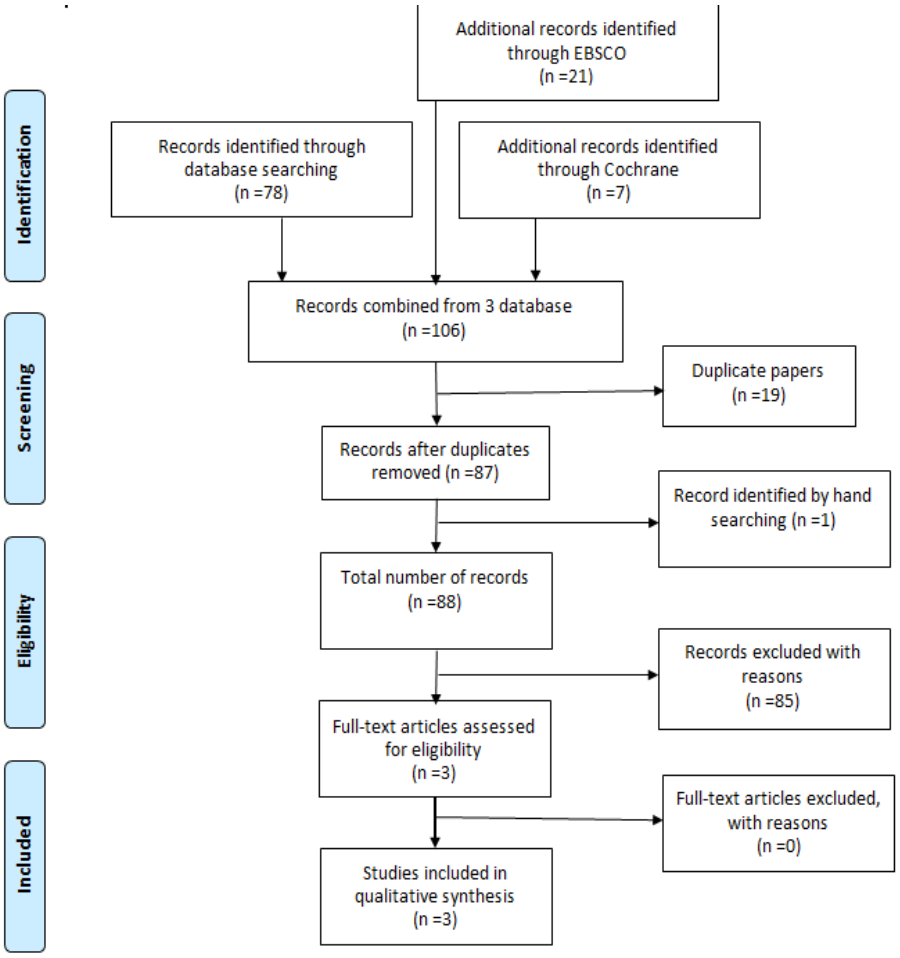

Figure 1:- Flow diagram for the search results.

Table 1:- Quality Assessment Table.

Studies	Did the study include keywords that identify areas covered in the study?	Did the study address a clearly focused question?	Are the aims and purpose of the study clearly stated?	Are the details of the technique sufficiently given to allow its transferability to other clinical setting?	Are the outcomes of the studies clearly stated?	Are the outcomes measured using a defined method?	Are the methods of collecting data clearly described?	Is the case clearly described?	Are the results credible and relevant for practice?	Are the conclusions drawn justified by the results?	Quality assessment score
(Ding et al. 2009)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	8/10
(Nagy et al. 2014)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10/10
(Narang et al. 2015)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10/10

Table 2:- Characteristics of studies included in the systematic review.

Ref	Country of origin	Year of publication	Study design	Randomization	Informed consent obtained?	Ethical approval	Setting	Aim of study
(Ding et al. 2009)	China	2009	A Clinical Study	Not randomized	The patients and their parents were informed of the treatment plan and the potential risks before giving their consent to the treatment.	Not clear	the Pediatric Dentistry clinic of the School of Stomatology of Peking University, Beijing, China	The aim was to examine the effect of a revascularization procedure on immature teeth with apical periodontitis
(Nagy et al. 2014)	Egypt	2014	Randomized control trial	randomized but method unclear	Informed consent was signed for each case by the patient's parents or guardians including the proposed treatment and possible outcomes or complications.	The Ethical Committee of the Faculty of Dentistry, Ain Shams University.	Clinic of the Faculty of Dentistry, Ain Shams University, Cairo, Egypt.	The aim was to assess the regenerative potential of young permanent immature teeth with necrotic pulps after the following treatment protocols: (1) an MTA apical plug, (2) the regenerative endodontic protocol (blood clot scaffold), and (3) the regenerative endodontic with a blood clot and an injectable scaffold impregnated with basic fibroblast growth factor (bFGF).
(Narang et al. 2015)	India	2015	clinical trial	block randomization	Written informed consent was obtained from all the subjects participating in the study.	The research protocol was approved by Institutional Reviews Board at Banaras Hindu University, Varanasi	The study was conducted in Department of Conservative Dentistry and Endodontics at Sir Sunderlal Hospital, BHU between September 2010 and August 2011.	The aim was to evaluate and compare the regenerative potential of the blood clot, PRP, and PRF in immature necrotic permanent teeth.

Table 3:- Methodological table.

Ref	No	Type of teeth	Age	Gender	Grouping	instrumentation	irrigation	Intracanal medication	Canal filled	Follow up	Drop out
(Ding et al. 2009)	12	5 incisors and 7 premolar	8-11 y	Male = 5 Female = 7	REG= 6 Apex =6	No	20 mL of 5.25% NaOCl	TPA (mixture of ciprofloxacin, metronidazole, minocycline) For 1 week	REG: Blood clot, Grey MTA and resin Bonded rest Apex: a standard apexification procedure	12–15 month	3 patient drop out
(Nagy et al. 2014)	36	All teeth are max incisors	9-13 y	Female = 12 Male =14	1-MTA apical plug =12 2-REG w blood clot=12 3-fibroblast growth factor group=12	minimal	10 mL 2.6% NaOCl	Metronidazole ciprofloxacin, doxycycline For 3 weeks	Rev: Blood clot, MTA, adhesive composite resin Apex: MTA Plug, thermoplasticized gutta-percha	3, 6, 12, 18 month	Apex= 3 Reg = 2
(Narang et al. 2015)	20	Not available	below 20 years of age	Not available	1-MTA apex =5 2-Rev with Blood clot=5 3-Rev with PRP + collagen=5 4-Rev with Platelet-rich Fibrin matrix=5	minimal	2.5% NaOCl	Triple antibiotic paste For 4 weeks	Rev: Blood clot, resin modified glass ionomer cement ,composite Apex: MTA placed as apical plug, thermoplasticized gutta-percha and AH Plus Sealer, adhesive rest	6 and 18 month	No drop out

Table 4:- Outcome Table.

Outcomes		(Ding et al. 2009)	(Nagy et al. 2014)		(Narang et al. 2015)
Clinical Evaluation	Name	Pain gingival condition	Clinical Success rate		Clinical evaluation
	Tool	Asking patient question Visual exam	Signs and symptoms of failure		relief from pain, absence of swelling, drainage and resolution of sinus
	Unit	Present/ absent clinically acceptable/Not	Presence or absent		Fair by 1, Good by 2, and Excellent by 3,
	Result	Presented in 2 patients and shifted to Apex group clinically acceptable in all 3 teeth	The success rates for the MTA apexification and REG groups were 100%, 90%, respectively		Clinically, all the groups showed excellent results. Patients were asymptomatic with no tenderness on either percussion or palpation. The swelling and sinus had resolved completely.
increased root length	Name	increased root length	An increase in root length		root lengthening
	Tool	Radio-graphically	Image j software		Radiovisiography software
	Unit	Evident /not	Millimeters	percent	Fair by 1, Good by 2, and Excellent by 3
	Result	evident in all 3 teeth	MTA / Rev 3 m=0 ± 0/0.3 ± 0.2 6 m=0 ± 0/0.6 ± 0.3 12 m=0 ± 0/0.8 ±0.5 18 m=0 ± 0/1.2 ± 0.5	MTA / Rev 3 m=0 ± 0 / 3 ± 3.5 6 m =0 ± 0/ 5.3 ± 2.6 12 m=0 ±0 /7.6 ± 4.7 18 m=0 ± 0/11.8±4.9	Apex: No root lengthening Rev: good results were obtained in 40% of the cases
increased root canal wall thickness	Name	increased root canal wall thickness	An increase in root thickness		dentinal wall thickening
	Tool	Radio-graphically	Image j software		Radiovisiography software
	Unit	Evident /not	millimeters	percent	Fair by 1, Good by 2, and Excellent by 3
	Result	evident in all 3 teeth	MTA / Rev 3 m=0 ± 0/0.04±0.03 6 m =0± 0/0.14±0.03 12 m=0±0/0.21±0.08 18 m=0±0/0.32±0.12	MTA / Rev 3 m= 0±0/1.8 ± 1.3 6 m=0±0/5.8 ± 1.2 12 m= 0±0/8.4 ± 3.2 18 m=0±0/12.7 ± 4.7	Apex: No dentinal wall thickening Rev: good results were obtained in 50% of cases
Apical closure	Name	Apical closure	A decrease in apical diameter		apical closure
	Tool	Radio-graphically	Image j software		Radiovisiography software
	Unit	Present/absent	millimeters	percent	Fair by 1, Good by 2, and Excellent by 3
	Result	Present in all 3 teeth	MTA / Rev 3 m= 0±0/0.08 ±0.04 6 m=0±0/0.22 ±0.11 12 m=0±0/0.67±0.04 18 m=0±0/0.8 ± 0.3	MTA / Rev 3 m=0 ±0/6.4 ± 3.2 6 m=0±0/17.6 ± 8.8 12 m=0±0/34.6 ± 2 18 m=0±0/50.5±18.9	Apex: No apical closure Rev: good results were obtained 66.67% of the cases
A change in periapical	Name	Not available	A change in periapical bone density		periapical healing
	Tool	Not available	Digora		Radiovisiography software

bone density	Unit	Not available	percentage of change in density	Fair by 1, Good by 2, and Excellent by 3
	Result	Not available	MTA - Rev 3 months= 4.47 ± 5.6 - 2.21± 1.9 6 months = 8.71 ± 3.2 - 6.43 ± 2.1 12 months=11.25 ± 7.8 - 10.91 ± 6.2 18 months=14.61± 7.1 - 12.77 ± 5.5	Apex: not available Rev: good results were obtained in 60% of the cases
regained pulp sensibility	Name	regained pulp sensibility	Not available	Not available
	Tool	electric pulp tester	Not available	Not available
	Unit	+ve/-ve	Not available	Not available
	Result	+ve in all 3 teeth	Not available	Not available

Conclusion:-

The use of the pulp revascularization technique has been identified as an effective method to allow increase in root length, width and apical closure in immature necrotic teeth. However, there isn't enough histological and clinical studies assessing its action within root canals, and there is a lack of standardization of the parameters used for clinical procedure.

Based on the included articles for this review, revascularization group showed marked increase in the root length, width and apical closure in the cases that were reported.

To provide the actual success rate of this technique, further randomized control clinical studies with standardized radiographic imaging during follow-up visit. Also, longer follow periods are required to assess its effect on inducing further root development, thickening of radicular dentin and apical closure.

References:-

1. Al Ansary, M. A. D., Day, P. F., Duggal, M. S., and Brunton, P. A. (2009): Interventions for treating traumatized necrotic immature permanent anterior teeth: inducing a calcific barrier & root strengthening. Dent. Traumatol., 25: 367–379.
2. Hargreaves K, L. A. (2011): Regenerative Endodontics. In: C. S. Hargreaves K (10 eds) Pathways of the pulp, St Louis: Mosby Elsevier, pp. 602–619.
3. Hargreaves, K. M., Giesler, T., Henry, M., and Wang, Y. (2008): Regeneration potential of the young permanent tooth: what does the future hold?. J Endod., 34(7): S51–S56.
4. Huang, G. T.-J. (2009): Apexification: the beginning of its end. Int Endod J., 42: 855–866.
5. Khetarpal, A., Chaudhary, S., Talwar, S., Ravi, R., & Verma, M. (2013): Revascularization of Immature Permanent Tooth with Periapical Lesion using a New Biomaterial - A Case Report. Int. J. Dent. Sci. Res., 1(1): 20–22.
6. Mente, J., Hage, N., Pfefferle, T., Koch, M. J., Dreyhaupt, J., Staehle, H. J., & Friedman, S. (2009): Mineral trioxide aggregate apical plugs in teeth with open apical foramina: a retrospective analysis of treatment outcome. J Endod., 35: 1354–1358.
7. Rafter, M. (2005): Apexification: a review. Dental Traumatology., 21: 1–8.
8. Shah, N., Logani, A., Bhaskar, U., & Aggarwal, V. (2008): Efficacy of revascularization to induce apexification/apexogensis in infected, nonvital, immature teeth: a pilot clinical study. J Endod., 34(8): 919–25