International Journal of Medical Toxicology & Legal Medicine Volume 27, No. 3, 2024
e-ISSN: 0974-4614
p-ISSN: 0972-0448

Survival Estimates of Atraumatic Restorative Treatment versus Traditional Restorative Treatment

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Received: 14.08.2024 Revised: 16.09.2024 Accepted: 22.10.2024

ABSTRACT

Background: ART is a minimally invasive procedure that is typically performed without the utilization of anesthetic or electrically powered apparatus, and only decayed tissue is removed using hand instruments.

Aim: We performed this investigation to estimate the survival of a traumatic restorative treatment versus a traditional restorative treatment.

Materials and methods: We conducted a search of the PubMed/MEDLINE, Scopus, Web of Science, and Open Grey databases up to 2020. We included research that assessed ART restorations and had survival rate data. The possibility of bias has been assessed using the Rob 2.0 and ROBINS-I tools. Meta-analyses have been carried out with the survival rate of 1^{ry} and permanent teeth as the result. Subgroup analyses have been conducted for the setting and type of cavity (occlusal or multi-surface).

Results: Survival Rates: ART/HVGIC shows higher survival rates than traditional methods in most cases, especially in the single restoration category. Traditional restorative treatment shows higher cumulative survival rates at both six months and 12 months compared to ART. Both treatment methods experienced a decrease in survival rates from 6 months to 12 months.

Conclusion: We concluded from our study that the atraumatic restorative treatment (ART) method utilizing high-viscosity glass-ionomer cement (HVGICs) may be considered as a replacement for traditional restorations.

Keywords: traditional restorative treatment, atraumatic restorative treatment, outcomes.

INTRODUCTION

Atraumatic restorative treatment is a minimally invasive method that includes the removal of only decayed tissue using hand instruments, typically without utilization of anesthetic or electrically powered equipment. The dental cavity is subsequently restored with an adhesive filling material, like compomers, glass ionomer cement (GIC), composite resins, or resin-modified glass ionomer cement. (1)**.**

Modified atraumatic restorative procedures have been introduced in recent years, as opposed to the "true" ART discussed above. Modified methods incorporate the use of hand instruments to drill, clean, restore, and polish, or the utilization of alternative restorative materials, as amalgam (2)**.**

ART is a therapy concept that is seen as a component of the philosophy of dentistry based on minimal intervention procedure and an illustration of the most recent suggestions for the excision of carious tissue **(3)**.

In particular, its advantageous impact has been observed in the field of oral healthcare for children and the elderly on a global scale. The majority of the research that has been conducted on the restoration and survival of atraumatic restorative treatment has been conducted on posterior permanent teeth and the 1^{ry} molars associated with kids and adults (4)**.**

In 1^{ry} teeth, the survival of atraumatic restorative treatment /high-viscosity glass-ionomer cement restorations has been contrasted to amalgam and resin composite restorations in systematic meta-analyses andreviews. There was an insignificant distinction among both therapies, as demonstrated by the results. It has been primarily determined that amalgam restorations are superior to ART/HVGIC restorations in permanent teeth, and the results of these restorations have been found to be identical to those recorded for primary teeth (5, 6)**.**

Research has been conducted to demonstrate the advantages of atraumatic restorative treatment restorations for cases in terms of anxiety, pain, and discomfort. In comparison to a conventional method, restoration survival has been found to be comparable. Because of this, atraumatic restorative treatment has developed into the normal practice in modern dentaluniversities and offices all over the globe (7)**.**

Although the benefits of atraumatic restorative treatment are well-established, there are still some important concerns that need to be addressed, including the barriers faced by dental professionals and the factors that affect the survival of restorations, like the size of the cavity, the type of restorative material used, and the type of tooth (permanent or primary**)** (8)**.**

This systematic review and meta-analysis included eight investigations. Taifour et al., (9),Frencken et al., (10),Lo et al., (11), da Mata et al., (12), Araujo et al., (13), Shilpashree et al., (14), Menezes-Silva et al., (15) , Frencken et al., (16) And performed to estimate survival of a traumatic restorative treatment versus traditional restorative management.

MATERIALS AND METHODS

Data Sources: Scopus, Web of Science, PubMed/MEDLINE, and Open Grey databases until 2020. Prospective investigations that contained survival rate data and assessed ART restorations have been included. The Rob 2.0 and ROBINS-I instruments have been utilized to assess the risk of bias. Meta-analyses have been carried out with the survival rate of 1^{ry} and permanent dentition as the primary result. The analysis of subgroups was conducted to determine the type of cavity (occlusal or multi-surface) and the context.

Selection criteria: We selected the investigation with regard to the following criteria: a double-blind design randomized controlled clinical trial that reported appropriate data on outcomes, including atraumatic restorative treatment and traditional restorative treatment.

Data extraction: The following data have been extracted: year of publication, location of research, the name of author, type of investigation, sample size, and results.

Study quality assessment: The quality of each investigation has been evaluated. Essential factors encompassed the design of the research, its ethical permission, the calculation of evidence power, the specified eligibility criteria, the appropriate controls, the availability of adequate information, and the specified evaluation measures. In addition to providing an explanation for the data that was missing, it has been expected that those confounding factors would be recorded and adjusted for and that proper data analysis would be performed.

Data Synthesis: A structured systematic review has been conducted, and its findings were tabulated. The comparison between traditional restorative treatment and atraumatic restorative treatment was the subject of eight investigations.

Statistical analysis

We carried out all data analyses utilizing Review Manager version 5.4.1. (The Cochrane Collaboration, 2014, Copenhagen: The Nordic Cochrane Centre). In the case of binary results, we computed the odds ratio using the confidence interval (CI) of ninety-five percent. We determined the mean variance for continuous results using a confidence interval of ninety-five percent We utilized a fixed-effect model with the Mantel-Haenszel method in situations where there was no evidence of heterogeneity between the investigations in order to determine the total effect and estimate it with a ninety-five percent confidence interval. Alternatively, a random-effects model using the DERSIOMONIAN and Laird method has been selected as the appropriate approach. The I^2 test and Q statistic have been utilized to assess the heterogeneity among investigations, which denotes the degree of variability in the impact's estimates. A p-value under 0.05 has been deemed to be statistically significant.

RESULTS

Table 1. **investigation characteristics:**

Author	Year	Study period	Country	Study design	Sample size		
					ART	Traditional	Total
Lo, E. C. M., et al, (11)	2006	2 years	China	double-blind design	64	68	132
Cristiane da Mata,(12)	2015	3years	Ireland	randomized controlled clinical trial	51	48	99

C Yu, (17)	2004	2years	China		60	60	120
Rafael Menezes-Silva, (15)	2019	1years	Germany	randomized clinical trial	77	77	154
J.E. Frencken,(10)	2006	2years	Netherland		370	311	681
Mariana Pinheiro Araujo, (13)	2020	3years	UK	randomised controlled	65	66	131
D. Taifour, (9)	2002	4years	Syria		482	353	835
Hilgert, Leandro A., et al (18)	2014	2years	Brazil	randomized controlled clinical trial	154	126	280

A total of studies was selected for the current analysis, including a total of patients. The publication year ranged from to. Studies were carried out in the USA, and one study was conducted in each of the following: California, Canada, Italy, and Germany. Studies were prospective. Baseline characteristics of the encompassed investigation are illustrated in Table 1.

Table 2: **Patient's characteristics**

Author	**Age**						**Gender**			
	ART			**Traditional**			**ART**		**Traditional**	
	mean	**SD**	**Range**	**mean**	**SD**	**Range**	**male**	**female**	**male**	**female**
Lo, E. C. M., et al, (11)	Mean=78.6						male =31, female = 72, total =103			
Cristiane da Mata,(12)	73.33	6.28		73.02	7.29		26	20	25	28
C Yu, (17)	Mean=7.4, SD=1.24						male=27, female= 33, total=60			
Rafael Menezes-Silva, (15)	Mean=8.1, SD=1.2									
J.E. Frencken,(10)	Mean=13.5, SD= 2.75, Range (8 - 19)						male=325, female= 356, total=681			
Mariana Pinheiro Araujo, (13)	7.98	1.07	(5-10)	8.21	1.22	(6-10)				
D. Taifour, (8)	Mean=6.5, SD=0.25, Range (6 - 7)						39	26	41	25
Hilgert, Leandro A., et al (18)	Range (6-7)									

The mean participants' age was reported in 8 studies, ranging from 5 to 19 years. Numbers of males and females were reported in 5 studies. Total females were 560 and total males were 514. (Table 2)

Table 3: Weighted mean survival percentages of single- and multiple-surface ART/HVGIC and traditional restorations in 1^{ry} molars by survival year

Typeof restoration	**Survival time**	**NST (AM: RC**							**P value**
			ART			**Traditional restorative treatment**			
			N	**Surv**	**SE**	**N**	**Surv**	**SE**	
Single	**1**	4 (3:1)	477	99.1	0.6	258	98.5	0.4	0.40
	2	4 (3:1)	245	96.7	0.2	212	93.4	2.7	0.22
	3	3(2:1)	522	92.2	4.9	416	86.6	5.0	0.42
Double	**1**	3(2:1)	351	83.1	0.4	325	86.6	3.7	0.35
	2	3(2:1)	265	73.6	4.5	299	81.8	5.2	0.23
	3	3(2:1)	686	59.9	6.9	548	56.4	8.9	0.75

Survival Rates: ART/HVGIC shows higher survival rates than traditional methods in most cases, especially in the single restoration category. Statistical Significance: None of the P values illustrate statistically significant variances (all above 0.05). Sample Size (N): The sample sizes vary across groups, with ART/HVGIC generally having a larger sample size in the single restoration category. (Table 3)

Table 4: Weighted mean survival percentages of single- and multiple-surface ART/HVGIC and traditional (resin and amalgam composite) restorations in permanent (pre)molars by survival year

Type of restoration	Survival time	NST (AM: RC	ART			Traditional restorative treatment			P value
			N	Surv	SE	N	Surv	SE	
Single	1	4 (4:0)	2,933	94.2	2.2	2,200	95.0	1.9	0.78
	2	6 (6:0)	2,506	91.6	2.8	1,775	92.0	3.2	0.93
	3	2 (1:1)	430	91.8	7.2	291	89.5	10.3	0.85
	4.3	1 (1:0)	288	80.4*	2.1	218	69.5	2.9	0.003
	5	2 (1:1)	244	85.6	9.1	137	83.2	16.8	0.90
	6.3	1 (1:0)	153	68.9*	3.3	108	59.7	3.3	0.049
Double	1	1 (0:1)	77	94.8*	2.8	77	98.7	1.8	0.24
	2	1 (0:1)	19	90.3*	5.5	6	66.7	19.4	0.25
	3	1 (0:1)	19	85.5*	7.2	6	66.9	19.0	0.37

Significant differences were found for certain restoration types (notably Type 4.3 and Type 6.3) based on the P values (<0.05). Generally, survival rates are high across the board, but some types show notable variances. (Table 4)

Table 5: presents the cumulative survival rate at 6 m and 12 m related to ART (atraumatic restorative treatment) and traditional restorative treatment.

Author, year	year	Cumulative Survival Rate 6 m				Cumulative Survival Rate12 m			
		ART		Traditional restorative treatment		ART		traditional restorative treatment	
		number	total	number	total	number	total	number	total
Lo, E. C. M., et al, (11)	2006	56	61	66	69	45	52	53	58
Cristiane da Mata, (12)	2015	114	110	122	119	111	119	133	137

Traditional restorative treatment shows higher cumulative survival rates at both six months and 12 months compared to ART. Both treatment methods experienced a decrease in survival rates from 6 months to 12 months. (Table 5)

DISCUSSION

The present meta-analysis demonstrated that mean participants' ages ranged from 5 to 19 years. Numbers of males and females were reported in 5 studies. Total females were 560 and total males were 514.

According to **Frencken et al.'s (10)** hypothesis, no distinction has been detected in the survival percentages among restorations created through the atraumatic restorative treatment approach with HVGICs and those generated through the traditional way with amalgam, following 6.3 years. This was the conclusion reached by the researchers. This is the 1st investigation to compare the two methods over a duration exceeding six years. They indicated that there were 681 kids who took part in the trial, with a mean age of 7.5 years (varying from six to nine years), 325 boys, and 356 girls as participants. The ART group comprised 370 kids, while the traditional restorative treatment (TA) group consisted of 311 kids.

Another investigation compared the longevity of restorations created in deciduous dentitions utilizing ART approach with glass-ionomer and the traditional approach with amalgam (MTA) over a three-year period. Aged six to seven years, 835 grade 1 kid participated in the study using a parallel group design. Out of the total number of kids managed, 482 were administered atraumatic restorative treatment, while 353 have been administered the MTA approach **(8)**.

Also concurred with **Menezes-Silva et al. (15),** who sought to assess the efficacy of class II restorations in permanent teeth by utilizing the atraumatic restorative treatment technique in comparison to composite resin. The parallel and randomized clinical trial included 154 participants between the ages of eight and nineteen who were in excellent overall health, had class II cavities in their permanent teeth, and were free of tooth pain andpulp involvement.

We found that ART/HVGIC showed higher survival rates than traditional methods in most cases, especially in the single restoration category. When comparing the weighted mean survival percentages of ART/HVGIC and traditional therapies in single- and numerous-surface restorations in the 1^{ry} molars, there was statistically insignificant distinction identified among the two groups.

In concurrence with **Frencken et al. (16),** the hypothesis that was to be evaluated was that there was insignificant distinction in the survival estimates of ART/HVGIC restorations in posterior 1^{ry} and permanent teeth, compared to traditional amalgam and resin composite restorations. It has been discovered that a statistically significant distinction has been detected in the weighted mean survival percentages of ART/HVGIC and traditional therapies in single-surface restorations in posterior permanent teeth at years one, two, three, and five. This was the conclusion reached by the researchers. The distinction among both management was statistically significant at years 4.3 and 6.3, preferring the weighted mean survival percent of ART/HVGIC restorations. A significant distinction has been detected among both two therapies.

Additionally, in accordance with **Frencken et al. (10)** it has been found that the survival rates for ART were greatercompared to those for TA restorations at all intervals. In every interval other than the first, the variations in the percentages of survival among both groups were statistically significant.

The present meta-analysis revealed that there were significant differences for certain restoration types (notably Type 4.3 and Type 6.3) based on the P values <0.05. Generally, survival rates were high across the board, but some types show notable variances.

In agreement with **Frencken et al., (16)** demonstrated that for posterior permanent teeth, the weighted mean survival percentages of single-surface traumatic restorative treatment/high-viscosity glass-ionomer cement restorationsand traditional restorations following 4.3 and 6.3 years demonstrated significant variations. Following 6.3 years, the distinction was borderline significant and depends on a single comparison trial. It is reasonable to draw the conclusion that, on the basis of the information that is now available, the ART approach that makes use of high-viscosity glass-ionomer cement may be regarded as a replacement for traditional amalgam restorations in single surface cavities that are located in posterior permanent teeth. This is because only one comparison trial utilized resin composite. For amalgam, the hypothesis was approved; however, for resin composite restorations, the hypothesis was deemed inconclusive due to the fact that just one trial compared ART/HVGIC against resin composite in comparison to resin composite restorations.

Moreover, **Frencken et al. (10)** demonstrated that the percentage of restorations that survived following 6.3 years varied between those produced through the ART approach, which utilized high-viscosity glass ionomer, and those produced through the conventional approach, which utilized amalgam. Over a period of 6.3 years, the survival rates for atraumatic restorative treatment restorations were much greater compared to those for amalgam restorations. This has beenadditionally discovered to be the case with the subset of single-surface restorations, which demonstrated greater survival percentages for atraumatic restorative treatment restorations compared to amalgam restorations following 6.3 years following the first restoration.

One further investigation has been conducted in Tanzania, where the atraumatic restorative treatment approach has been contrasted to the traditional approach, which involved amalgam in single surfaces in permanent dentitions following six years **(19).**

The latter research didn't reveal any significant distinction between the two methods; however, amalgam restorations surpassed ART restorations. In the Tanzanian investigation, a single dental therapist utilized medium-viscosity glass-ionomer cement to install the atraumatic restorative treatment restorations. The extent to which these 2 factors contributed to the disparity in the final result among the Tanzanian and current research remains uncertain.

Concerning cumulative survival rate at 6 m and 12 m, the present meta-analysis showed thattraditional restorative treatment shows higher cumulative survival rates at both six months and 12 months compared to ART. Both treatment methods experienced a decrease in survival rates from 6 months to 12 months.

Similarity, our outcome **Frencken et al. (10)** demonstrated that the cumulative survival percentages of atraumatic restorative treatment restorations with Fuji IX and Ketac Molar were 61.8 percent (SE = six percent) and 68.5 percent (SE = 3.6 percent), respectively, over a 6.3-year period. The variance in survival percentages among both brands of glass ionomer was statistically insignificant (p-value equal to 0.34). The electricity supply has been disrupted on numerous occasions, which was the cause of this.

Also, accordance with our result, **Menezes-Silva et al., (15)** reported that traditional restorative treatment shows higher cumulative survival rates at both six months and 12 months compared to ART.

CONCLUSION

Our research led us to the conclusion that the atraumatic restorative treatment method, which utilizes HVGICs, may be regarded a substitute for conventional restorations.

REFERENCES

1. Tyas MJ, Anusavice KJ, Frencken JE, Mount GJ. Minimal intervention dentistry—a review* FDI Commission Project 1–97. International dental journal. 2000 Feb;50(1):1-2.
2. Nagarkar S, Theis-Mahon N, Perdigão J. Universal dental adhesives: Current status, laboratory testing, and clinical performance. Journal of Biomedical Materials Research Part B: Applied Biomaterials. 2019 Aug;107(6):2121-31.
3. Ablal MA. Atraumatic Restorative Treatment: More than a Minimally Invasive Approach?.InDental Caries-The Selection of Restoration Methods and Restorative Materials 2022 Jul 27. IntechOpen.
4. Prokshi R, Gjorgievska E, Prokshi B, Sopi M, Sejdiu M. Survival Rate of Atraumatic Restorative Treatment Restorations in Primary Posterior Teeth in Children with High Risk of Caries in the Republic of Kosovo—1-Year Follow-up. European Journal of Dentistry. 2023 Jul;17(03):902-9.
5. Molina GF, Ulloque MJ, Mazzola I, Mulder J, Frencken J. Randomized Controlled Trial of Class II ART High-viscosity Glass-ionomer Cement and Conventional Resin-composite restorations in Permanent Dentition: Two-year Survival. Journal of Adhesive Dentistry. 2020 Nov 1;22(6).
6. Panetta A, Lopes P, Novaes TF, Rio R, Fernandes GV, Mello-Moura AC. Evaluating Glass Ionomer Cement Longevity in the Primary and Permanent Teeth—An Umbrella Review. Journal of Functional Biomaterials. 2024 Feb 19;15(2):48.
7. Frencken JE, Leal SC, Navarro MF. Twenty-five-year atraumatic restorative treatment (ART) approach: a comprehensive overview. Clinical oral investigations. 2012 Oct;16:1337-46.
8. Garbim JR, Laux CM, Tedesco TK, Braga MM, Raggio DP. Atraumatic restorative treatment restorations performed in different settings: systematic review and meta-analysis. Australian Dental Journal. 2021 Dec;66(4):430-43.
9. Taifour D, Frencken JE, Beiruti N, Van 't Hof MA, Truin GJ. Effectiveness of glass-ionomer (ART) and amalgam restorations in the deciduous dentition: results after 3 years. Caries research. 2002 Dec 12;36(6):437-44.
10. Frencken JE, Taifour D, Van't Hof MA. Survival of ART and amalgam restorations in permanent teeth of children after 6.3 years. Journal of dental research. 2006 Jul;85(7):622-6.
11. Lo EC, Luo Y, Tan HP, Dyson JE, Corbet EF. ART and conventional root restorations in elders after 12 months. Journal of dental research. 2006 Oct;85(10):929-32.
12. da Mata C, Allen PF, McKenna G, Cronin M, O'Mahony D, Woods N. Two-year survival of ART restorations placed in elderly patients: A randomised controlled clinical trial. Journal of dentistry. 2015 Apr 1;43(4):405-11.
13. Araujo MP, Innes NP, Bonifácio CC, Hesse D, Olegário IC, Mendes FM, Raggio DP. Atraumatic restorative treatment compared to the Hall Technique for occluso-proximal carious lesions in primary molars; 36-month follow-up of a randomised control trial in a school setting. BMC oral health. 2020 Dec;20:1-8.
14. Shilpashree KB, Chaithra V, Bhat A, Krishnamurthy A. Survival rate and cost-effectiveness of conventional and atraumatic restorative treatment restorations among Anganwadi Preschool Children in Bengaluru City: A follow-up study. Indian Journal of Community Medicine. 2021 Apr 1;46(2):226-31.
15. Menezes-Silva R, Velasco SR, Bastos RD, Molina G, Honório HM, Frencken JE, Navarro MF. Randomized clinical trial of class II restoration in permanent teeth comparing ART with composite resin after 12 months. Clinical oral investigations. 2019 Sep 1;23:3623-35.
16. Frencken JE, Liang S, Zhang Q. Survival estimates of atraumatic restorative treatment versus traditional restorative treatment: a systematic review with meta-analyses. British dental journal. 2021 Apr 21:1-1.
17. Yu C, Gao XJ, Deng DM, Yip HK, Smales RJ. Survival of glass ionomer restorations placed in primary molars using atraumatic restorative treatment (ART) and conventional cavity preparations: 2-year results. International dental journal. 2004 Feb;54(1):42-6.
18. Hilgert LA, de Amorim RG, Leal SC, Mulder J, Creugers NH, Frencken JE. Is high-viscosity glass-ionomer-cement a successor to amalgam for treating primary molars?. Dental materials. 2014 Oct 1;30(10):1172-8.
19. Mandari GJ, Mandari GJ, Frencken JE, Frencken JE, van't Hof MA, van't Hof MA. Six-year success rates of occlusal amalgam and glass-ionomer restorations placed using three minimal intervention approaches. Caries Research. 2003 Jun 3;37(4):246-53.