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**REMOÇÃO PARCIAL DE DENTINA CARIADA EM LESÕES
DE CÁRIE PROFUNDAS: DOIS ANOS DE
ACOMPANHAMENTO CLÍNICO**

Trabalho de conclusão de curso apresentado na Faculdade de Odontologia da Universidade Federal do Rio Grande do Sul, como requisito parcial para obtenção do título de cirurgião-dentista, com área de concentração em cariologia/dentística.

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PORTO ALEGRE

2009

DEDICATÓRIA

Aos meus pais, *Rodolfo* e *Lione*, que me proporcionaram o exemplo de perseverança e ética para atingir todos os meus objetivos.

À minha irmã, *Marília*, pela amizade e pela presença em todos os momentos mais importantes da minha vida.

AGRADECIMENTOS

À professora *Marisa Maltz*, pelos quatro anos de orientação, incentivando meu crescimento como aluno de odontologia e como pesquisador.

À doutoranda *Juliana Jobim Jardim*, pelo desenvolvimento inicial desta pesquisa, pelo auxílio na sua continuidade e, principalmente, pela amizade construída em quatro anos de convivência.

À professora *Clarissa Fatturi Parolo*, pela disponibilidade em ensinar, pelo apoio e amizade constante durante todo o período de iniciação científica.

À mestranda *Fernanda Cristina Mendes de Santana Giongo*, pela presença em muitos momentos da minha formação, proporcionando alegria e grande amizade.

À doutoranda *Luana Severo Alves* e às mestrandas *Luciana Bitello Firmino* e *Roberta Garcia*, pelo apoio na finalização desta pesquisa.

Às professoras *Heliana Dantas Mestrinho* e *Lilian Marly De Paula*, pela dedicação e esforço na continuidade desta pesquisa.

Às professoras *Berenice Barbachan e Silva*, *Lina Naomi Hashizume* e *Sandra Henz*, pelo profissionalismo e pela colaboração no meu crescimento como pesquisador.

À laboratorista *Tânia Peres*, pelos cuidados e dedicação a mim e ao laboratório.

À colega de turma e de iniciação científica *Caroline Machado Weber*, pelos cinco anos de companheirismo, coleguismo e amizade.

Às colegas de iniciação científica *Alessandra Damo*, *Bruna Mua* e *Camilla Ferreira do Nascimento*, pela companhia constante no laboratório.

Aos colegas de graduação *Aline Wunderlich Rocha, Maurício José Santos Moreira e Paulo Ricardo Matje Baccarin*, pela grande amizade e pela companhia em todos os momentos destes cinco anos de faculdade.

Aos *pacientes*, pelo interesse e colaboração.

“Não confunda derrotas com fracasso nem vitórias com sucesso. Na vida de um campeão sempre haverá algumas derrotas, assim como na vida de um perdedor sempre haverá vitórias. A diferença é que, enquanto os campeões crescem nas derrotas, os perdedores se acomodam nas vitórias”.

Roberto Shinyashiki

RESUMO

O objetivo deste ensaio clínico controlado randomizado multicêntrico (Porto Alegre e Brasília) foi avaliar a efetividade de uma abordagem alternativa em lesões de cárie profundas após dois anos de acompanhamento. O tratamento consistiu na remoção parcial de dentina cariada e restauração em única sessão (RPDC). Participaram do estudo indivíduos a partir de nove anos de idade, com molares permanentes com lesões de cárie profundas, ausência de alteração periapical (exame radiográfico), sensibilidade pulpar positiva (teste térmico), ausência de dor espontânea e sensibilidade à percussão negativa. Os indivíduos foram randomicamente atribuídos ao grupo teste - RPDC, ou grupo controle - tratamento expectante (TE). O TE consistiu na remoção parcial de dentina cariada, capeamento pulpar indireto com cimento de hidróxido de cálcio, restauração provisória, reabertura da cavidade após 60 dias, remoção da dentina cariada remanescente e restauração. Todas as cavidades foram forradas com cimento de ionômero de vidro e restauradas com resina composta ou amálgama. Foram executados 293 tratamentos, 146 RPDC e 147 TE. Não houve diferença entre os grupos em relação às variáveis basais (gênero, idade e renda familiar). No segundo ano de acompanhamento, foram realizadas 113 avaliações. Os resultados foram obtidos a partir de parâmetros indicadores de vitalidade pulpar: sensibilidade pulpar (teste térmico) e ausência de lesão periapical (exame radiográfico). A taxa de sucesso após dois anos foi de 87% e 73% na RPDC e no TE, respectivamente ($p < 0,05$). Motivos de insucesso: RPDC - 2 hiperemias, 3 pulpites e 2 necroses; TE - 12 pulpites, 3 necroses, 1 tratamento endodôntico e 1 extração. Não houve associação significativa entre as variáveis analisadas (gênero, idade, tratamento, material restaurador e número de superfícies restauradas) e o desfecho clínico. Os resultados sugerem que RPDC é o tratamento de eleição para lesões de cárie profundas quando comparada ao TE. CNPq (403420/04-0) FAPERGS (04/1531-8), apoio financeiro da DFL, Ivoclar/Vivadent e SDI.

Palavras-chaves: Lesões profundas, lesões de cárie profundas, remoção parcial de dentina cariada, capeamento pulpar indireto, tratamento expectante.

ABSTRACT

The aim of this multicenter randomized controlled clinical trial was to evaluate the effectiveness of an alternative approach for deep caries lesions in Brazil (Porto Alegre and Brasilia) after 2-year of follow-up. The treatment consisted of partial caries removal followed by restoration in a single session (PCR). Inclusion criteria: patients who were \geq nine years old presenting permanent molars with primary deep lesion reaching inner half of dentine, absence of periapical alterations (radiographic exam), pulpal sensibility (cold test), absence of spontaneous pain and negative percussion test. The subjects were randomly assigned to test group - PCR, or control group - stepwise excavation (SE). SE consisted of partial removal of carious dentine, indirect pulp capping with calcium hydroxide cement, temporary filling, cavity re-opening after 60 days, removal of the remaining soft carious dentine and filling. All cavities were lined with glass ionomer cement and restored with resin composite or amalgam. Two hundred and ninety three treatments were performed, 146 PCR and 147 SE. There were no differences between the groups regarding baseline characteristics (gender, age and family income). The outcome was defined as pulp sensibility to cold test and absence of periapical alterations, assuming those parameters are indicators of pulp vitality. After two years 113 teeth were evaluated showing a success rate of showing 87% and 73% in PCR and SE, respectively ($p < 0.05$). Reasons for failures: PCR - 2 hyperemias, 3 pulpitis and 2 necrosis; SE - 12 pulpitis, 3 necrosis, 1 endodontic treatment and 1 extraction. None variable (gender, age, treatment, restorative material and number of restored surfaces) was significantly associated with the outcome. The results suggest that PCR seems to be the preferred treatment for deep caries lesions when compared with SE. Grants: CNPq (403420/04-0) FAPERGS (04/1531-8), financial support from Ivoclar/Vivadent, DFL and SDI.

Key words: Deep caries, deep caries lesions, partial caries removal, indirect pulp capping, stepwise excavation.

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ANTECEDENTES E JUSTIFICATIVA

A doença cárie é a maior responsável pela perda dentária em todas as idades (BAELUM *et al.*, 1997). Apesar do aperfeiçoamento dos métodos e critérios de diagnóstico bem como da disponibilidade de recursos para o controle da atividade cariogênica, lesões cariosas em estágios avançados de progressão ainda estão presentes na prática clínica. O tratamento dessas lesões visa possibilitar o controle mecânico do biofilme e restabelecer função e estética ao dente através da restauração das estruturas perdidas (KIDD, 2004).

O tratamento restaurador tradicional tem como etapa fundamental a remoção completa de dentina cariada baseada no critério clínico de dureza. Essa técnica objetiva a paralisação do processo carioso pela eliminação das bactérias viáveis durante o preparo cavitário. Entretanto, é sabido que o critério de dureza clínica não assegura a ausência de microrganismos (MACGREGOR; MARSLAND; BATTY, 1956; WHITEHEAD; MACGREGOR; MARSLAND, 1960; SHOVELTON, 1968), e que esses são rotineiramente selados sob restaurações.

O manejo tradicional da dentina cariada em lesões de cárie profundas pode resultar em exposição pulpar, exigindo medidas de tratamento mais invasivas como capeamento pulpar direto, pulpotomia ou pulpectomia, o que torna o prognóstico menos previsível (BARTHEL *et al.*, 2000). A remoção de dentina cariada em duas etapas, também chamada de tratamento expectante, tem sido sugerida para minimizar a ocorrência de exposição pulpar e, por conseguinte, destas possíveis complicações. Este tratamento consiste na remoção total da dentina cariada localizada nas paredes circundantes da cavidade e na remoção superficial da dentina cariada presente na parede pulpar seguida do selamento temporário da cavidade. Após um período de 45 dias a nove meses, são realizadas a escavação do tecido cariado remanescente e a restauração. Durante o período de selamento temporário, é esperado que ocorram reações fisiológicas do complexo dentino-pulpar representadas pela esclerose dentinária e deposição de dentina terciária, proporcionando proteção à polpa durante a reintervenção (KING; CRAWFORD; LINDAHL, 1965; MASSLER, 1978). Estudo realizado em dentição decídua observou maior frequência de exposição pulpar durante a escavação de dentina cariada em única etapa comparada à sua execução através do tratamento expectante (MAGNUSSON; SUNDELL, 1977). Em dentes permanentes jovens, foi registrado um índice de 40% de exposição pulpar quando realizado o tratamento tradicional e de 17,5% durante a remoção de dentina cariada em duas etapas (LEKSELL *et al.*, 1996).

Apesar destes resultados favoráveis ao tratamento expectante, a necessidade de reintervenção na cavidade pode ser considerada uma desvantagem, pois aumenta o custo necessário para conclusão do tratamento e gera risco de exposição pulpar durante a remoção do material provisório ou durante a escavação final da dentina cariada. Estudo realizado na Universidade Federal do Rio Grande do Sul, no qual o sucesso do tratamento expectante executado por alunos de graduação foi avaliado, indicou a baixa frequência de retorno do paciente, a fratura da restauração provisória e o conseqüente agravamento do quadro clínico como precursores do insucesso deste tratamento e da possível perda dentária (PAROLO, 2003).

O selamento da dentina cariada como parte do protocolo de execução do tratamento expectante levou ao desenvolvimento de diversos estudos clínicos, de microdureza, radiográficos e microbiológicos, a fim de avaliar as possíveis alterações na lesão cariada selada sob a restauração. Os resultados clínicos indicaram modificação na coloração e consistência da dentina cariada remanescente, que se tornou similar a de lesões inativas de acordo com os critérios de coloração e dureza (BJØRNDAL; LARSEN; THYLSTRUP, 1997; BJØRNDAL; THYLSTRUP, 1998; PINTO *et al.*, 2006; MALTZ *et al.*, 2002). Essas alterações foram confirmadas através de análises laboratoriais de microdureza em dentes decíduos esfoliados (MARCHI *et al.*, 2008; FRANZON *et al.*, 2009). Em estudo radiográfico foi observado o aumento da radiopacidade na zona radiolúcida abaixo da restauração, sugerindo aumento do conteúdo mineral na dentina cariada (MALTZ *et al.*, 2002; ALVES *et al.*, 2009). As análises microbiológicas indicaram a redução na quantidade de bactérias viáveis na dentina cariada após o seu selamento, possivelmente resultante da falta de disponibilidade de nutrientes (BJØRNDAL; LARSEN; THYLSTRUP, 1997; BJØRNDAL; LARSEN, 2000; MALTZ *et al.*, 2002; PINTO *et al.*, 2006; WAMBIER *et al.*, 2007; ORHAN; OZCELIK; ORHAN, 2008). BJØRNDAL e LARSEN (2000) observaram alterações microbiológicas qualitativas, em que a microbiota tornou-se menos complexa após seu isolamento do meio ambiente bucal. Um estudo longitudinal acompanhou por 10 anos pacientes submetidos ao selamento de lesões cariosas restritas à metade externa da dentina, observando uma taxa de sucesso de 86% (MERTZ-FAIRHURST *et al.*, 1998). Esse resultado demonstra que os sinais e sintomas de paralisação do processo carioso, já observados poucos meses após o selamento da dentina cariada, são mantidos ao longo do tempo.

Recentemente, tem sido questionada na literatura a necessidade de reintervenção para escavação final da dentina cariada selada em lesões de cárie profundas (KIDD, 2004; RICKETTS *et al.*, 2008). Existem poucos estudos que avaliam a realização de remoção

parcial de dentina cariada e restauração definitiva em única sessão. Na dentição decídua, a execução dessa técnica é denominada capeamento pulpar indireto (KING; CRAWFORD; LINDAHL, 1965) e sua indicação tem sido justificada pelo fato de que o dente decíduo tem restrito período de permanência na cavidade bucal (RIBEIRO *et al.*, 1999; FALSTER *et al.*, 2002; PINTO *et al.*, 2006; FRANZON *et al.*, 2007; CASAGRANDE *et al.*, 2008).

Uma série de publicações (MALTZ *et al.*, 2002; 2007; OLIVEIRA *et al.*, 2006; ALVES, 2009) analisou a remoção parcial de dentina cariada em lesões de cárie profundas na dentição permanente. Mediante a análise clínica e radiográfica, foi registrada uma taxa de sucesso de 63% após 10 anos de acompanhamento dos pacientes, demonstrando a manutenção da sensibilidade pulpar na maioria dos casos tratados (ALVES, 2009).

Apesar de todas estas evidências demonstrando a paralisação do processo carioso após o selamento da dentina cariada em dentes decíduos e permanentes, em lesões cariosas superficiais e profundas, com variados períodos de selamento e acompanhamento dos pacientes, e utilizando diferentes metodologias para avaliação das alterações na dentina selada, não estão disponíveis na literatura ensaios clínicos randomizados controlados que avaliem a efetividade da remoção parcial de dentina cariada como uma etapa definitiva do tratamento restaurador. É esperada, através da execução dessa técnica, a eliminação das possíveis complicações originadas pela escavação dentinária em duas etapas e um desfecho clínico de manutenção da sensibilidade pulpar.

ARTIGO

**PARTIAL CARIES REMOVAL IN DEEP LESIONS: A 2-YEAR
FOLLOW-UP STUDY.**

PARTIAL CARIES REMOVAL IN DEEP LESIONS: A 2-YEAR FOLLOW-UP
STUDY.

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SHORT TITTLE: Partial caries removal: 2-year follow-up.

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INTRODUCTION

The conventional treatment of deep caries lesions involves complete removal of carious dentine followed by tooth restoration. In this technique, there is a potential risk of iatrogenic pulp exposure making the course of the treatment less predictable. Alternative approaches have been proposed to preserve pulp sensibility, such as indirect pulp capping (1) and stepwise excavation (2). This latter method consists in the removal of decayed tissue in two sessions. At the first appointment a layer of soft and humid dentine is left over the cavity floor and the tooth is temporarily filled. After variable time intervals, the residual carious dentine is removed before the placement of the definitive restoration. The aim of caries excavation in two steps is to allow the occurrence of physiological reactions in the pulp-dentine complex represented by dentine sclerosis and tertiary dentine formation (1, 3), ensuring protection to pulp tissue on the re-entry. Some studies had presented favorable results for this treatment (4, 5). However, disadvantages related to the need of reopening for further excavation have been described, as the risk of pulp exposure while re-entering the cavity, the failure of the temporary filling leading to caries progression, the default of the patient at the second appointment and additional costs and discomfort to the patient.

Recently, the real need to re-enter the cavity has been questioned in the literature (6, 7), taking into account the evidences of caries arrestment after its isolation from the oral environment. Several studies have shown clinical, microhardness, radiographic and microbiological modifications at the carious dentine after its sealing: (a) clinical signs of darkening and hardening (5, 8, 9), which was confirmed by microhardness measurements (10, 11); (b) radiographic increase of the mineral content (9, 12, 13, 14)

and (c) substantial reduction of bacterial contamination due to the lack of nutrition (8-10). On a long-term basis, a 10-year follow-up study showed the control of caries process by sealants placed on caries lesions restricted to the outer half of dentine, recording a success rate of 86% (15). Based on the all the evidences described above, it has been suggested that the partial caries removal technique and the placement of the definitive restoration can be done at a single appointment, eliminating the possible complications of the stepwise excavation (6, 7).

A series of publication derived from a single-arm clinical trial showed favorable results of the partial caries removal in deep lesions (9, 13, 14, 16). After 10 years of monitoring, the success rate was 63% (16). Despite the importance of this study due to its long-term follow-up period and low drop-out rate, the lack of a control group impedes the assessment of the effectiveness of this treatment, turning essential the development of randomized controlled clinical trials.

The aim of the present study was to assess longitudinally patients with deep caries lesions submitted to partial caries removal after a period of 2-year, regarding tooth sensibility.

MATERIAL AND METHODS

This multicenter randomized controlled clinical trial (registration number at www.clinicaltrials.gov NCT00887952) was conducted with patients submitted to a conservative approach to treat deep caries lesions in the permanent dentition. Clinical procedures were carried out in the Federal University of Rio Grande do Sul, Faculty of Sciences Health of the University of Brasilia and Public Health Services. This study

was approved by the Ethics Committees of Federal University of Rio Grande do Sul and University of Brasília. All patients were included in a preventive/therapeutic program. They or their legal guardians signed a free informed consent.

The initial sample consisted of 293 permanent posterior teeth with deep caries lesion from 234 patients (9 - 53 years of age). The inclusion criteria were: radiographic image of caries lesion in the inner half of dentine, positive response to the cold test with -20° refrigerated gas (Aerojet, Rio de Janeiro, RJ, Brazil), negative sensitivity to percussion test, no history of spontaneous pain, radiographic absence of a periapical lesion and absence of cuspal loss.

The patients were randomly assigned by raffle to: (1) test group - partial caries removal and restoration in one session (PCR) and (2) control group - stepwise excavation (SE). The raffle was performed by an assistant during the clinical procedure. Each of the groups was divided according to the filling material, determined at weekly basis, alternating between amalgam and resin composite.

Clinical procedures

The patients were submitted to the following procedures: anesthesia and rubber dam isolation of the area to be treated; access to the affected area using rotator instruments, if necessary; complete caries removal from the surrounding cavity walls according to hardness criteria (rotator instruments and/or hand excavator); removal of the necrotic disorganized dentine from the cavity floor (hand excavator); washing of the cavity with distilled water; drying with sterile filter paper; group randomization. The tooth of the PCR received: partial filling of the cavity with glass ionomer cement (Vitro Fil, DFL, Rio de Janeiro, RJ, Brazil); restoration using amalgam (SDI, Bayswater WA,

Australia) or resin composite (Ivoclar Vivadent, São Paulo, SP, Brazil). The tooth of the SE received: indirect pulp capping with calcium hydroxide cement (Dycal, Caulk/Dentsply, Rio de Janeiro, RJ, Brazil) and temporary filling with a modified zinc oxide-eugenol cement (IRM, Caulk/Dentsply, Rio de Janeiro, RJ, Brazil); cavity reopening after 60 days, followed by removal of the remaining decayed dentine and filling according to the same procedures described to PCR.

Clinic and radiographic evaluation

The treatment was evaluated after one and two years using the clinical and radiographic criteria. Pulp sensitivity was assessed by cold test and patients were asked about the occurrence of pain or sensitivity during percussion, assuming those parameters as indicators of pulp sensibility. Periapical radiographs were taken to analyze the integrity of the periapical region. All evaluations were performed by a trained examiner.

Statistical data processing

Qui-square test and Mann-Whitney test were used to compare PCR and SE according to baseline characteristics.

Survival analyses were performed to estimate therapy success rate at different time points (1-year and 2-year follow-up). The time to failure was displayed through Kaplan-Meier survival curves. Log-rank test was used to compare the experimental groups.

Logistic regression analysis was used to investigate possible associations between dichotomous outcome variable (success vs. failure) and independent variables: treatment, number of restored surfaces, age and gender.

Qui-square test or Mann-Whitney test were used to compare patients followed-up after two years and patients lost to recall.

A p-value less lower 0.05 was considered statistically significant.

Statistical analyses were conducted using the Statistical Package for Social Science (SPSS) software, version 13.0, for Windows.

RESULTS

There were 293 treatments performed, 146 PCR and 147 SE.

There were no differences between the groups regarding baseline characteristics: age, gender and family income (Table 1).

During the performance of the SE three cases of pulp exposure were observed. These cases were treated with direct pulp capping.

The number of evaluated teeth after 1 and 2 years follow-ups is shown in table 2.

A total of 24 therapeutic failures were observed, 7 in the PCR and 17 in the SE. Reasons for failure in the PCR were pulpitis (n=3), necrosis (n=2), hyperemia (n=2). In SE, failures occurred due to pulpitis (n=12), necrosis (n=3), extraction (n=1) and endodontics treatment (n=1). There is no information regarding the reason for the extraction and endodontic treatment in the SE.

After 2 years of follow-up, therapy survival rates of PCR and SE was 87% and 74%, respectively ($p < 0.05$) (Figure 1).

At the logistic regression analysis, there was no significant association between the variables age, gender, family income, restorative material, number of restored surfaces and treatment included in the model, and the outcomes (Table 3).

The cumulative drop-out rate was 51%. There were no differences between the evaluated patients and those lost to recall regarding family income, gender, restorative material and number of restored surface. However, differences were found regarding age and treatment (Table 4).

DISCUSSION

In the present study, two treatments were performed: partial caries removal and stepwise excavation. After the clinical procedures, annual assessments have been carried out in order to monitor patients regarding pulp sensitivity.

Current evidences in the literature have shown the control of caries progression by means of the sealing of carious dentine. The indirect pulp capping is usually the treatment indicated to of deep caries lesions in primary dentition, in which a thin layer of carious dentine is left over the pulp to avoid pulp exposure. This technique has been studied at a long-term basis. The study with the longest time of patients monitoring showed a success rate of 88% after five years (17). In permanent dentition, there are only two longitudinal studies on the sealing of carious dentine as a definitive therapy. Mertz-Fairhurst et. al. (15) performed the sealing of shallow caries lesions and showed a success rate of 86% after 10 years. In deep caries lesions, Alves (16) showed a success rate of 63% at the same time interval.

Although studies present favorable results to partial caries removal both in primary and permanent dentition, there is no randomized controlled clinical trial evaluating this approach. The great advantage of the present study is the inclusion of a control group to evaluate the efficiency of the partial caries removal in deep caries lesions in permanent teeth. Stepwise excavation was chosen as the control group due to the high success rate found in several studies. Long-term study showed a success rate of 92% following 3.5-4.5 years of monitoring (18). In our study, however, after 2 years of follow-up, a success rate of 73% was reached. The occurrence of pulp exposure during final excavation and no return of the patient to the re-enter were the most common complications recorded in this period. In this study, three cases of pulp exposure were recorded during the removal of the residual carious dentine, showing that although stepwise excavation decrease the risk of pulp exposure, this complication may occur. Complete caries removal, on the other hand, presents a high rate of pulp exposure (4), being direct pulp capping is the eligible treatment in order to preserve tooth sensitivity. However, despite this ultimate goal, long-term studies have shown unfavorable results regarding the maintenance of pulp vitality when direct pulp capping was performed to carious exposed pulp. In a 3-year study, only 33.3% of these cases remained vital (19). In a retrospective study, the pulp capped teeth showed a success rate of 55.5% after five years and 13% after 10 years of follow-up (20). These findings suggest that the stepwise excavation technique is more successful on a long-term basis than capping an exposed pulp.

In the present study, the stepwise excavation group recorded a high number of patients that no return to conclude the treatment in the second appointment, highlighting the difficulty of using this approach in the clinical practice. It is well known that the

failure of the temporary restoration may lead to caries progression and endodontic complications after a certain period of time. The dependence of patients' return to conclude the stepwise excavation, coupled with the lack of evidence of the need of cavity reopening for final excavation suggest that the treatment in a single appointment may be preferable.

Longitudinal clinical studies require patient collaboration to attending follow-up sessions. Out the 293 patients treated, 171 were monitored after one year and 113 after two years. In order to assess the possible inclusion of a bias, patients who attended the 2-year follow-up were compared with those lost to recall. The two variables which were significantly different from one another were age and treatment at the two years recall. Regarding age, the monitoring of patients older than those lost to recall does not seem to compromise our results. Considering that it is suggested that younger pulps react better against an injury than older ones, the inclusion of the younger lost patients could, at most, improve our results. Regarding treatment, the higher drop-out rate observed in the stepwise excavation, which presented worse success rate, emphasizes its inferiority. It could be expected that the more patients in this group are evaluated, the greater the failure rate is.

Based on the present findings, it is possible to conclude that the partial caries removal and restoration in a single session is a more successful therapy than stepwise excavation after two years. This result suggests that it is unnecessary to completely remove carious dentine prior to a restoration in order to maintain pulp sensibility.

ACKNOWLEDGEMENTS

We thank the support of National Coordination of Post-graduate Education (CAPES), Brazilian Ministry of Science and Technology through its agency National Council of Research (CNPq - Process number: 40.3420/04-0), Research Support Fund of Rio Grande do Sul (FAPERGS - Process number: 04/1531-8) and the support of the industries DFL (Rio de Janeiro, Brazil), Ivoclar/Vivadent (São Paulo, Brazil) and SDI (Bayswater WA, Australia).

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TABLES

TABLE 1. Subjects baseline characteristics according to the treatments.

GROUP / VARIABLE	N	AGE (YEARS) MEAN±SD	MALE	FEMALE	FAMILY INCOME (R\$)
					1R\$ = 2,90 US\$ MEDIAN (QUARTILES 75 AND 25)
SE	147	16.6±7.5	56	91	600.00 (800.00-380.00)
PCR	146	16.3±7.2	49	97	600.00 (960.00-380.00)

There were no differences between the groups at baseline ($p>0.05$).

TABLE 2. Number of evaluated teeth and outcomes.

TIME / RATINGS	PCR		TE		TOTAL
	SUCCESS	INSUCCESS	SUCCESS	INSUCCESS	
1 YEAR	94	1	60	16	171
2 YEARS	62	6	44	1	113

TABLE 3. Differences between the experimental groups according to the subjects baseline characteristics.

VARIABLE	p*
GENDER	0.265
AGE	0.813
TREATMENT	0.254
RESTORATIVE MATERIAL	0.223
NUMBER OF RESTORED SURFACES	0.124

TABLE 4. Differences between the experimental group and the non-respondents according to the subjects baseline characteristics.

VARIABLE	p*
GENDER	0.638
AGE	0.029
FAMILY INCOME	0.146
TREATMENT	0.015
RESTORATIVE MATERIAL	0.245
NUMBER OF RESTORED SURFACES	0.068

FIGURE

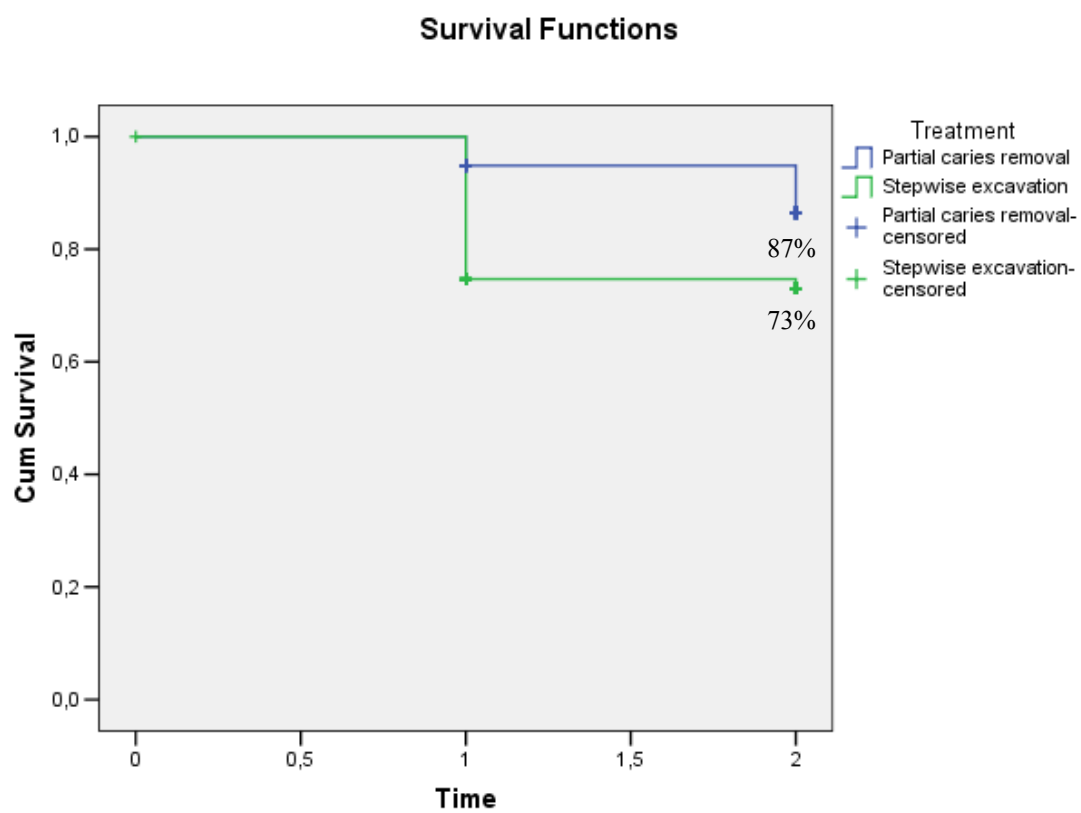


FIGURE 1. Therapy survival rate.

CONSIDERAÇÕES FINAIS

Baseado no resultado do presente estudo podemos concluir que a remoção parcial de dentina cariada em única sessão apresenta melhor prognóstico que o tratamento expectante. Os resultados sugerem que é desnecessária a remoção completa de dentina cariada antes da colocação da restauração para a manutenção da sensibilidade pulpar.

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