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Title Page

Carious lesion management in children and adolescents by Australian dentists

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Key words: Adolescents, children, caries management, dental caries, restorative threshold.

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Abstract

Background: The management of carious lesions in children and adolescents can have lifelong implications for the patient. The present study's aim was to assess the decision-making process of dentists when managing carious lesions in children and adolescents.

Methods: Approximately 11,000 dentists listed as members of the Australian Dental Association Inc. (ADA) and Australian and New Zealand Society of Paediatric Dentistry (ANZSPD) were emailed a link in April 2017 to a 19-question survey delivered by SurveyMonkey™.

Results: 887 responses were received. In 'enamel-limited' carious lesions, dentists intervened most frequently in primary tooth approximal (365, 41.1%), followed by permanent tooth occlusal (295, 33.3%) and approximal (244, 27.5%), and primary tooth occlusal (203, 22.9%) surface carious lesions. Age, university of graduation, practicing state, decade of graduation and frequency of treatment of children between the 6-15 years were significant demographic factors influencing the restorative threshold.

Conclusions: Australian dentists reported significant variation in their management of approximal and occlusal carious lesions in both primary and permanent teeth. A substantial proportion of respondents would intervene surgically on non-cavitated enamel-limited lesions.

Key words: Adolescents, children, caries management, dental caries, restorative threshold.

Abbreviations

ADA – Australian Dental Association

ANZSPD – Australian and New Zealand Society of Paediatric Dentistry

DBA – Dental Board of Australia

DEJ – Dentine-enamel junction

GIC – Glass ionomer cement

HREC – Human Research Ethics Committee

MI – Minimal intervention

PRR – Preventive resin restoration

RC – Resin composite

RMGIC – Resin modified glass ionomer cement

Introduction

Dental caries is one of the most prevalent diseases affecting children and adolescents and carries with it a significant burden for individuals and society.[1] Dental caries is a multi-factorial, dynamic process with bacterial, host, genetic, environmental and behavioural components[2-4] ; it cannot be cured in the context of the highly processed, added-sugar modern diet - it is a lifelong challenge that must be managed.[5]

Minimal intervention (MI) in dentistry is a philosophy that applies to all aspects of dentistry.[4,6-10] MI, as it relates to dental caries, is based on the premise that invasive surgical procedures do not address the underlying causative factors of dental caries. This position has been adopted due to the increasing knowledge of the caries process and the acceptance by many in the profession of the limitations and temporary nature of restorative treatment. The result has been in a shift towards addressing the underlying disease contributing factors. Restorations do not 'cure' the patient of dental caries, as they do not change the caries risk factors of a patient.[4,11,12]

The importance of MI cannot be over-emphasised in children and adolescents. Children treated according to MI benefit due to the lower number of restored surfaces and a reduction in exposure to invasive procedures.[13] Furthermore, as the lifespan of their permanent teeth is potentially very long, inapproriate restorative procedures can affect their survival disproportionately.[14]

Highlighting the importance of MI is not to undermine the requirement of high quality restorations. Restorations restore function, form and aesthetics which aid plaque control and protect the pulp-dentine complex.[5,15,16] The presence of a cavitated lesion commonly precludes adequate biofilm removal and cleansability.[16] Furthermore, the ability to remineralise carious lesions in enamel primarily relates to the preservation of surface integrity.[17]

Two Australian surveys related to approximal carious lesion management have been conducted in Western Australia and Victoria. In the Western Australian study (1991) public practitioners were surveyed,[18] whereas the Victorian study (1996) involved both private and public practitioners.[19] Ideally, the national approach adopted by the current research project can guide public policy, education and teaching practices in Australia and allow comparison with international data. The present study aimed to investigate how Australian dentists manage carious lesions in children and adolescents via a questionnaire.

Materials and methods

Ethical approval was obtained from the University of Melbourne Human Research Ethics Committee (HREC 1647296.1) with a subsequent amendment sought and approved (HREC 1647296.2). The survey was delivered via a web-based provider, SurveyMonkey™ (SurveyMonkey, CA, USA).

Recruitment strategy

The Australian Dental Association Inc. (ADA) agreed to send a single information and enrolment email to its active practising members (approximately 11,000) on the 8th of April 2017. One of the authors (TK) attended the 2017 ADA biennial congress in Melbourne, Australia, to survey members on an ad hoc basis during lunch and tea break periods. A link was provided on the ADA congress webpage and ADA App under the information tab. The Australian and New Zealand Society of Paediatric Dentistry (ANZSPD) emailed the survey link to 336 members on the 30th of March 2017. A reminder link was also sent on 10th May 2017.

The questionnaire (19 questions) was adapted from the one developed by Profs. Michèle Muller-Bolla and Sophie Doméjean.[20-22] Participants were asked to provide basic

demographic information followed by considering several clinical scenarios. A hypothetical scenario of a cooperative child, who has no other carious lesions, has good oral hygiene, uses a fluoridated toothpaste and visits their dentist annually was provided to participants. This was accompanied with six diagrammatic radiographic representations, corresponding to ICDAS 1 – 6 carious lesions[16], along with a written description (Fig. 1). Participants were asked to detail at which stage they would first intervene restoratively, how they would prepare the cavity and what restorative material would be employed. A similar situation was repeated for an occlusal carious lesion, with twelve pictures of carious lesions along with a text description provided. Once again, this corresponded to ICDAS 1 – 6 carious lesions[16] in primary and permanent teeth (Fig. 2). Finally, participants were asked, via a clinical photograph and radiograph, to give their opinion about the presence of a carious lesion on a primary molar and select their preferred management option (Table 2).[20-22]

Sample size

The sample size required was based on a confidence level of 95% and margin of error of 5%. With a population of 11,000 dentists, 372 participants were required to have adequate power to detect clinical significance. The ADA and ANZSPD were unable to release any demographic data of their members due to privacy legislation, nor confirm the exact number of email recipients. As contact details were unavailable to the research team a generic email was sent to all ADA and ANZSPD members. The email sent to ADA members highlighted that they should only complete the survey once.

Selection and cleaning of the data

The data was cleaned, with all responses transferred to IBM SPSS Statistics version 24, (IBM Inc., NY, USA). Data was transferred to Microsoft® Excel version 15.32 (Microsoft Organisation, WA, USA) to assist in visualisation for statistical analysis.

A flaw noted in the survey was that the practice location was a text box answer. To overcome the wide disparity in answers, the city or town was adjusted to reflect the state. Four dentists provided unclassifiable answers regarding location. These results were still conserved for analysis but excluded for any analysis based on state location. Practitioners who were retired or worked equally between public and private dentistry were excluded when analysing trends for the public or private category (five dentists). The data were, however, preserved for analysis in all other categories. In the recruitment email, it was noted that only Australian-

based dentists should complete the survey. When cleaning the data, any practitioners based in New Zealand were excluded.

Three subgroups ('before 1998', '1998-2007' and '2008-2017') were created for 'year of graduation', with four subgroups ('30 years and younger', '31-45 years', '46-60 years' and '61 years and more') for age. The first three stages for approximal and occlusal lesions, whereby the lesion had reached the dentine-enamel junction (DEJ), were grouped into the 'Enamel' category. Stages four to six, whereby the 'radiographic' lesion extended into dentine, were grouped into the 'Dentine' category. When asked to assess and manage the primary tooth presented in Table 2, the first four management options do not necessitate any physical removal of tooth structure and were termed 'non-surgical management'. Lesions that required physical removal of tooth structure were grouped into 'surgical management'.

Data cleaning was validated by selecting ten respondents randomly from the raw data and comparing all answers to the cleaned data, with no error detected.

Statistical analysis

Descriptive statistics were derived as well as cross-tabulations between demographic factors and answers to help guide further analysis, multiple logistic regression analyses were performed for restorative thresholds on primary and permanent approximal and occlusal carious lesions, either enamel or dentine. The level of significance was set at 5%. Initially Chi squared (χ^2) tests were performed followed by binary logistic regressions. This assisted in identifying insignificant independent factors, which were removed, and multiple logistic regression analyses were performed for the remaining independent factors.

When performing the χ^2 tests and multiple logistic regressions the independent factor 'university of education' had several categories of low responses (n<30), consequently several Universities were categorised into '*other'*. These included La Trobe, James Cook, Charles Sturt and Griffith Universities. The University of Otago was condensed into 'International'. A similar situation was noted for practicing state and the Australian Capital Territory, Northern Territory, South Australia and Tasmania were grouped into 'other'. This allowed statistical analysis without significant bias from the low response numbers.

Results

Response rate

A total of 887 dentists completed the survey, a response rate of approximately 8%.

Demographic data

Demographic data are presented in Table 1. Most participants reported that they practised primarily in private dental practices (83.1%), with general dentists dominating (93.2%). Participants practiced mostly in major cities (68%). Treating children aged under 6 years one to four times-per-week (46.1%) was the most frequent response. Children aged 6-15 years were treated most frequently five or more times-per-week (43.7%). Most respondents had undertaken continuing education in cariology within the last 5 years (77.6%).

Restorative threshold

Different stages of carious lesion progression are illustrated in Fig. 1 (approximal surfaces) and in Fig. 2 (occlusal surfaces). The dentists were asked to define their restorative threshold (to choose the earliest stage requiring immediate restorative management) in both primary and permanent teeth (Figs. 1 and 3). The restorative threshold in enamel-limited approximal carious lesions was selected by 41.1% of the respondents in primary teeth and 27.5% in permanent teeth; 33.3% of respondents chose to surgically intervene in enamel-limited occlusal carious lesions in permanent teeth, and 22.9% in primary teeth.

Preparation technique

The most popular preparation technique for approximal lesions was the box-slot cavity, which was described as an 'occluso-approximal preparation limiting the lesion opening and *the dentine excavation'*. This technique was selected by 59.6% of respondents when preparing a permanent tooth and 47% when preparing a primary tooth. The class II cavity preparation technique was selected by 26.3% and 28.9% of respondents respectively. The preferred preparation technique for occlusal lesions was '*Removal of carious tissue only'*; 90.5% of respondents selected this technique when preparing a primary tooth and 83.8% when preparing a permanent tooth.

Restorative material

The restorative materials selected for primary teeth varied significantly. Approximal lesions would be restored with either resin-modified glass ionomer cement (RMGIC) (28.5%), resin composite (RC) (28.2%), glass ionomer cement (GIC) (25.8%), or a combination of GIC and RC (10.7%) whilst compomer (4%), other (2.8%) and amalgam (0.9%) were rarely selected. A similar situation was noted for occlusal lesions, with RC (35.4%), GIC (30.1%) and RMGIC (25.4%) commonly selected, whilst a combination of GIC and RC (5.9%), compomer (2.3%), amalgam (0.6%) and other (0.5%) were rarely selected.

In permanent teeth, respondents overwhelmingly preferred the use of RC for approximal (70.9%) restorations, followed by a combination of GIC and RC (19.5%). Occlusal lesions were also restored with RC most frequently (73.2%).

Caries detection and management of an occlusal surface

A clinical photograph and radiograph of a carious lesion were provided to the participants to assess their visual assessment ability (Table 2), with the distribution of the diagnoses by dentists (Table 2); management options were presented in Fig. 4. Non-surgical management was slightly preferred (50.2%).

Independent factors that influence the stage the restorative threshold in approximal and occlusal carious lesions in primary and permanent teeth

A χ^2 analysis was performed to assess for any independent (demographic) factors that may influence the restorative threshold (enamel or dentine) in approximal and occlusal carious primary and permanent tooth lesions.

Statistically significant findings by site were: approximal lesions in primary teeth: gender ($p=0.015$), age ($p<0.001$), decade of graduation ($p=0.024$), university of education ($p<0.001$), practicing state ($p<0.001$), and attendance at conferences for continuing professional development on cariology ($p=0.048$); approximal lesions in permanent teeth: decade of graduation ($p=0.026$), university of education ($p=0.011$), registration as a dentist or specialist ($p=0.025$), practicing state ($p=0.002$) and membership of ANZSPD ($p=0.046$); occlusal lesions in primary teeth: no statistically significant associations; occlusal lesions in permanent teeth: age ($p=<0.001$), decade of graduation ($p<0.001$), university of education

(p=0.015), frequency of treatment of children 6-15 years (p=0.031) and practicing state (p=0.012).

The statistically significant factors from the χ^2 analysis were then all assessed with multiple logistic regression analyses, but only the statistically significant findings are reported in Table 3. Statistically significant findings by site were: approximal lesions in primary teeth: age (p=0.033), university of graduation (p=0.037), state of graduation (p=0.019); approximal lesions in permanent teeth: decade of graduation (p=0.008); occlusal lesions in permanent teeth: decade of graduation (p=0.032) and frequency of treatment of children 6-15 years (p=0.008).

Discussion

The use of questionnaire surveys to investigate restorative thresholds of dentists has been undertaken over several decades and in numerous countries, with limited data from Australian dentists. This survey aimed to establish national baseline for how Australian dentists manage approximal and occlusal carious lesions in children and adolescents.

The response rate for the present survey was low (approximately 8%), which is consistent with online surveys in comparison to traditional hard-copy mailed surveys.[23,24] Other postal questionnaire surveys conducted on the management of occlusal or approximal carious lesions by dentists reported response rates in the range of 40-90%.[24] Rechmann and colleagues recently conducted an online survey of dentists in California USA, obtaining a response rate of 11.3% from a population of 16,960 dentists.[24] The results and conclusions drawn from this research must be interpreted with caution due to the high risk of bias due to low proportional participation rates. Nevertheless, this is the first study of its kind in Australia and will establish a baseline for future comparison and satisfied the estimated sample size.

The survey population was compared to the available demographic data from the Dental Board of Australia (DBA) in 2017.[25] The survey population consisted of 42.8% females, with DBA registered dental professionals consisting of 50.2% females. The discrepancy between the populations could be explained by data for DBA registrants covering all dental practitioners, of which oral health therapists and dental therapists are predominately female.

Regarding the state distribution, Victoria was over-represented in the survey population compared to the DBA register. This could be explained by the location of the research team at the University of Melbourne, Victoria, and due to the location of the conference where attendees were surveyed, being held in Victoria. Dentists did not commonly report treating children younger than 6 years frequently and this could putatively be due to a range of reasons, including staffing of school dental services by OHTs and DTs and dentists' preference to treat older children and adults.

Management of approximal carious lesions

Approximal carious lesions assessed by radiographic techniques confined to the DEJ are much more likely to have intact surfaces than not. That is, only 8-19% are cavitated.[26-30] In the present study, 41.1% of respondents would surgically intervene in carious lesions confined to the DEJ in primary teeth and 27.5% in permanent teeth. This is concerning, as the likelihood of cavitation is low and the consequences of surgical intervention for approximal carious lesions confined within the DEJ far outweighs the risk of a non-operative approach. This could include oral hygiene and dietary advice, fluoride applications, resin infiltration and frequent monitoring.[31-34]

A review of the literature, in 2017, found 30 international surveys assessing the restorative threshold in permanent approximal carious lesions. With 27.5% of respondents indicating surgical intervention in enamel-limited lesions, Australian dental practitioners rated as the fifth least aggressive nation. Innes and Schwendicke conducted a systematic review and meta-analysis using the similar international surveys. They reported that 48% of dentists would surgically intervene when the lesion was confined radiographically within the DEJ.[35] Current Australian dentists were, in general, less aggressive than this, yet more aggressive than Scandinavian colleagues from nearly 20 years ago.[36,37]

Management of occlusal carious lesions

The proportion of respondents who suggested restorative treatment for an occlusal carious lesion confined to the DEJ was 22.9% for primary teeth and 33.3% for permanent teeth. A non-cavitated enamel lesion does not require any invasive management strategy particularly as the patient is low risk. Indeed, non-invasive techniques, such as sealants or topical fluoride are indicated.[5] The tooth could be reviewed at subsequent appointments to assess for lesion activity, progression and an intact sealant, if placed.[4,5]

Fifteen international studies were available for comparison, in 2017, of the restorative threshold in permanent occlusal carious lesions, with Australian dentists in the present survey the 11th least aggressive. Only five survey populations were more surgically interventionist with their management of occlusal carious lesions. Innes and Schwendicke's review found that 12% of dentists would intervene in enamel-limited carious lesions.[35] Australian dentists had higher intervention rates than this.

Implications and possible reasons for early surgical intervention

A dental restoration has a finite lifespan, with degradation of the restorative material, adhesive bond or surrounding tooth necessitating further treatment, initiating the restorative cycle. [8,38-40] It has also been estimated that dentists can spend up to 50-70% of their time on re-restoration, repair, or management of previously restored teeth.[41] This comes with time, financial, societal and quality-of-life implications, particularly for children and adolescents. [42,43] Education of dentists is paramount to ensure that they are implementing best practice evidence-based caries management principles.[44] This includes the concept that early surgical intervention is not always beneficial. This is particularly the case with the advent of highly sensitive detection tools, with relatively low specificity, that may direct the practitioner towards an overly interventionist approach.[45]

Several reasons have been proposed for why dentists intervene surgically too early. These include remuneration,[43,44,46-48] misunderstanding of evidence-based treatment,[48] assumption that more interventive care is better,[48,49] patients' expectation for a procedure to be performed and not advice given,[50] misunderstanding of the consequences of under- and over-treatment,[48,51,52] and, lack of faith in the ability of non-invasive treatments to halt caries progression.[53]

Pertaining to Australia, several putative assumptions can be made. The presence of a cariology department, or head of cariology, cannot be confirmed in all Australian universities. It may also emphasize the relative lack of importance that is placed by Australian dental schools on cariology when compared to other disciplines. Furthermore, in Australia, remuneration for dental care is based on the allocation of funds for specific item codes for any treatment provided. The scales of this remuneration are heavily in favour of

care which involves an invasive procedure, such as a restoration. The financial incentive to adopt non-invasive procedures, such as dietary and oral hygiene advice, is starkly lacking.

Preparation techniques

Traditional Class II preparations are overly destructive of healthy tooth structure and were indicated for restorative materials that required mechanical retention. As such, there is no justification for the use of this preparation technique in MI.[4] However, close to one-third of survey participants indicated they would use a traditional Class II preparation. The box-slot cavity preparation is a conservative modified restorative technique that aims to preserve as much healthy tooth structure as possible, with good five-year survival rates.[54] Reassuringly, this preparation technique was the most favoured in primary and permanent teeth.

The information provided to survey participants of an occlusal preparation was 'removal of *carious tissue only'* or *'open the entire fissure system'.* Conservation of tooth structure is paramount when deciding to embark on a surgical intervention; as such, selective removal of carious tissue is indicated.[54] Clinically, the difficulty for the dentist is actually determining what tissue should be removed. This information was not provided to the survey participants and the actual determination of what tissue should be removed or not was not investigated. The proportion of respondents, 9.5% in primary teeth and 16.2% in permanent teeth, who indicated they would open the entire fissure system displays the unnecessary destruction of healthy tooth structure.

Restorative material

No restorative material can truly replace the lost hard tissue structures of enamel and dentine.[54] A range of restorative materials is available to the dentist. When deciding upon the most appropriate restorative material to be used to restore a cavity, the dentist should be aware of the associated indications and contraindications.

In general, dentists used restorative materials appropriately. For example, RC was the most popular material in permanent tooth restorations and was the most popular material for restoration of primary occlusal cavities. It was the second most popular restorative material for approximal cavity restoration in primary teeth and use in these situations is supported by the literature.[55-59]

Of note, the use of GIC in primary teeth for approximal restorations was selected by around one-quarter of practitioners, with 6.9% and 3.3% of respondents selecting it for restoration of permanent tooth occlusal and approximal restorations, respectively. Use in these situations is not supported due to the susceptibility to fracture and wear, resulting in unacceptably high failure rates.[55, 60-64]

Preformed metal crowns have excellent success rates when restoring posterior primary teeth.[65] However, this option was not provided in the survey. This was done with the aim of preserving the integrity of the original survey for later comparison. Future surveys may wish to incorporate this option due to the success of this restorative material.

Diagnosis and management of an arrested enamel occlusal carious lesion

To assess the diagnostic skill of dentists, a clinical photograph and radiograph were provided to the participants. Visual examination has low sensitivity, yet high specificity, as do radiographs.[66-69] When coupled together it is noted that the sensitivity improves at the expense of specificity.[68] Despite the application of several other caries detection devices, visual examination and radiographs are the most relied upon detection and diagnostic tools for dentists.[68,70]

The most common carious status declared by the respondents for the occlusal surface shown in Figure 3 was a lesion clinically extending into dentine, with slightly over one-third identifying a carious lesion confined to enamel. The diagnostic process is important as it will guide the treatment decision, with significant consequences for both the tooth and the patient.[45] The high level of heterogeneity and potential misdiagnosis is likely to result in inappropriate treatment being provided. In the case of an arrested enamel occlusal carious lesion, preventive, non-invasive care can minimise progression of the carious lesion and allow for subsequent re-assessment.[7-9,11] Fluoride and sealants were recommended by over one third of dentists. It was not assessed whether oral hygiene and dietary advice would be recommended by these practitioners, which may be effective enough control measures in this case.[16]

Invasive restorative procedures, including a preventive resin restoration (PRR), were recommended by nearly half of the dentists. In this case, there was a very low likelihood of

cavitation in a low-risk patient. Therefore, plaque control would be able to be adequately performed, especially if the surface was sealed. Consequently, placement of a restoration was not indicated. Inappropriate restorative procedures can have a significant impact on the patient, particularly for a child.[13] The requirement to place an invasive restoration is determined by the presence of cavitation, to aid plaque control, protect the pulp-dentine complex and restore function, form and aesthetics.[5,16,69,71]

Independent factors influencing the restorative threshold for approximal and occlusal carious lesion in primary and permanent teeth

Dentists aged 30 years and younger intervened surgically in enamel confined approximal carious lesions in primary teeth more frequently than older dentists; consistent with two previous research projects[72,73] and in conflict with most other data available.[36,37,44,74-79] Perhaps life-experience instils a more pragmatic approach to carious lesion management in Australian dentists? Further research is required to investigate this assumption. Age did not significantly influence decision making for approximal and occlusal carious lesions in permanent teeth.

Dentists who graduated from the University of Sydney were the least invasive in enamel-limited approximal carious lesions in primary teeth compared to graduates from the Universities of Melbourne, Queensland, and Adelaide and International Universities. At the University of Sydney non-invasive caries management concepts have been taught for some time, although this has also been the case at many other Australian dental schools. From the results of this research project, this appears to be successful at Sydney Dental School when compared to other universities. Further research needs to be directed at the effects of teaching this approach.

When assessing carious lesions in permanent teeth, dentists who had graduated more recently, were more likely to delay the restorative threshold until the lesions had extended into dentine. Reassuringly this indicates that dental education facilities are teaching more up-to-date cariology management and is consistent with several other authors.[24,43,79-82]

The frequency of treatment of children aged 6-15 years had a statistically significant influence on the restorative threshold in occlusal carious lesions in permanent teeth.

Surprisingly, respondents who rarely treated children were the most likely to delay the restorative threshold until the lesion had extended into dentine. This is a concerning finding as early surgical intervention appears to be implemented by the respondents with the most interaction with children and adolescents, however, it can be hypothesized that those who treated children more often, also saw more serious complications of untreated or poorly treated carious lesions.

The aim of this research was to establish a baseline dataset for future comparison and ideally, to provide some information to dentists and the community on the status of carious lesion management by Australian dentists. This should help to improve the outcomes for dental patients in Australia.

Conclusions

In general, dentists in Australia were practicing carious lesion management in keeping with recommended principles. However, several practitioners still used overly destructive preparation techniques, and inappropriate restorative materials in enamel-confined carious lesions that could benefit from non-invasive strategies. There was significant heterogeneity in the diagnosis of an occlusal surface on a primary tooth, with essentially half recommending overly invasive management techniques. Several independent factors were noted to be significant for the restorative threshold on carious lesions. In particular, the discrepancy between several universities should be acknowledged, with graduates of the University of Sydney reporting more appropriate management decisions. Furthermore, at a public policy level, remuneration for items codes should be reviewed to promote the use of evidence-based non-invasive preventive practices.

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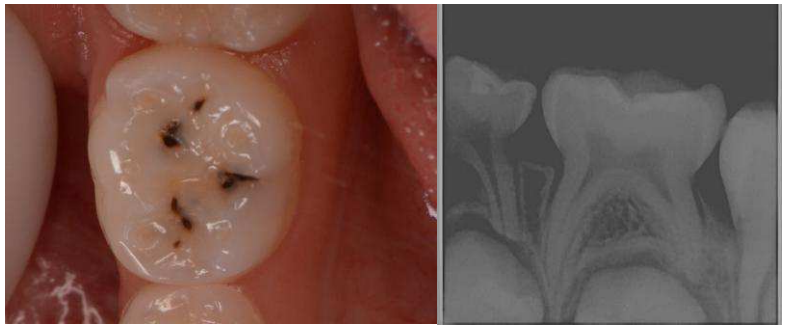
Table 1. Demographic characteristics

Demographic Factor	Dentists n (%) (N=887)	Demographic Factor	Dentists n (%) (N=887)	Demographic Factor	Participant Dentists n (%) (N=883)	Data from the DBA 2017 (%) (N=15,852)
Gender		**Education Facility of Graduation**		**Practicing State**		
Male	507 (57.2%)	University of Sydney	182 (20.5%)	ACT	26 (2.9%)	307 (1.9%)
Female	380 (42.8%)	University of Melbourne	167 (18.8%)	NSW	245 (27.8%)	5155 (32.5%)
Graduation years		University of Queensland	129 (14.5%)	NT	10 (1.1%)	98 (0.6%)
2008-2017	215 (24.2%)	University of Adelaide	98 (11%)	QLD	194 (22.0%)	3313 (20.9%)
1998-2007	173 (19.5%)	University of Western Australia	92 (10.4%)	SA	51 (5.8%)	1,154 (7.3%)
Before 1998	499 (56.3%)	University of Otago	29 (3.3%)	TAS	14 (1.6%)	242 (1.5%)
Age range		La Trobe University	5 (0.6%)	VIC	237 (26.8%)	3836 (24.2%)
30 and younger	138 (15.6%)	James Cook University	11 (1.2%)	WA	106 (12%)	1747 (11%)
31 - 45	289 (32.6%)	Charles Sturt	5 (0.6%)			

		University			
46 - 60	291 (32.8%)	Griffith University	23 (2.6%)		
61 and older	169 (19.1%)	International	146 (16.5%)		
Median age	46 y (± 13.7)				

ACT: Australian Capital Territory, DBA: Dental Board of Australia, NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia, y: Years

Table 2. Do you think that, from its clinical and radiographic appearance, the tooth has occlusal (enamel or dentin) carious lesion?



Carious status	Frequency n (%) N = (887)
No carious lesion	86 (9.7%)
Presence of carious lesion(s) confined to enamel	343 (38.6%)
Presence of carious lesion(s) extending into dentine	381 (43%)
Uncertain	77 (8.7%)

Table 3 Multiple logistic regression analysis for significant demographic factors

Type of tooth and site of carious lesion	Independent factor	Reference level	Base level	OR (95% CI)	P value	Overall P value
Primary teeth - Approximal lesions	Age	30 y and younger	31 - 45 y	2.09 (1.17, 3.74)	0.013	0.033
		30 y and younger	46 - 60 y	3.22 (1.45, 7,12)	0.004	
		30 y and younger	60 y and older	3.18 (1.36, 7.46)	0.008	
	University of education	Sydney	Melbourne	0.46 (0.25, 0.86)	0.015	0.037
			Queensland	0.49 (0.27, 0.90)	0.022	
			Adelaide	0.41 (0.22, 0.77)	0.006	
			International	0.39 (0.23, 0.65)	0.001	
	Practicing state	New South Wales	Other states	NA	NA	0.019
Permanent teeth –	Decade of	Before 1998	2008 - 2017	1.55 (1.02,	0.042	0.008

Approximal lesions	graduation			2.36)		
		Before 1998	1998 - 2007	1.86 (1.20, 2.88)	0.005	
Permanent teeth – Occlusal lesions	Decade of graduation	Before 1998	2008 - 2017	2.65 (1.23, 5.70)	0.013	0.032
		Before 1998	1998 - 2007	1.87 (1.03, 3.41)	0.041	
	Frequency of treatment of children between 6 and 15 y	5 children or more per week	Rarely	2.17 (1.33, 3.54)	0.002	0.008

OR: Odds ratio, CI: Confidence interval, NA: Not applicable, y: Years

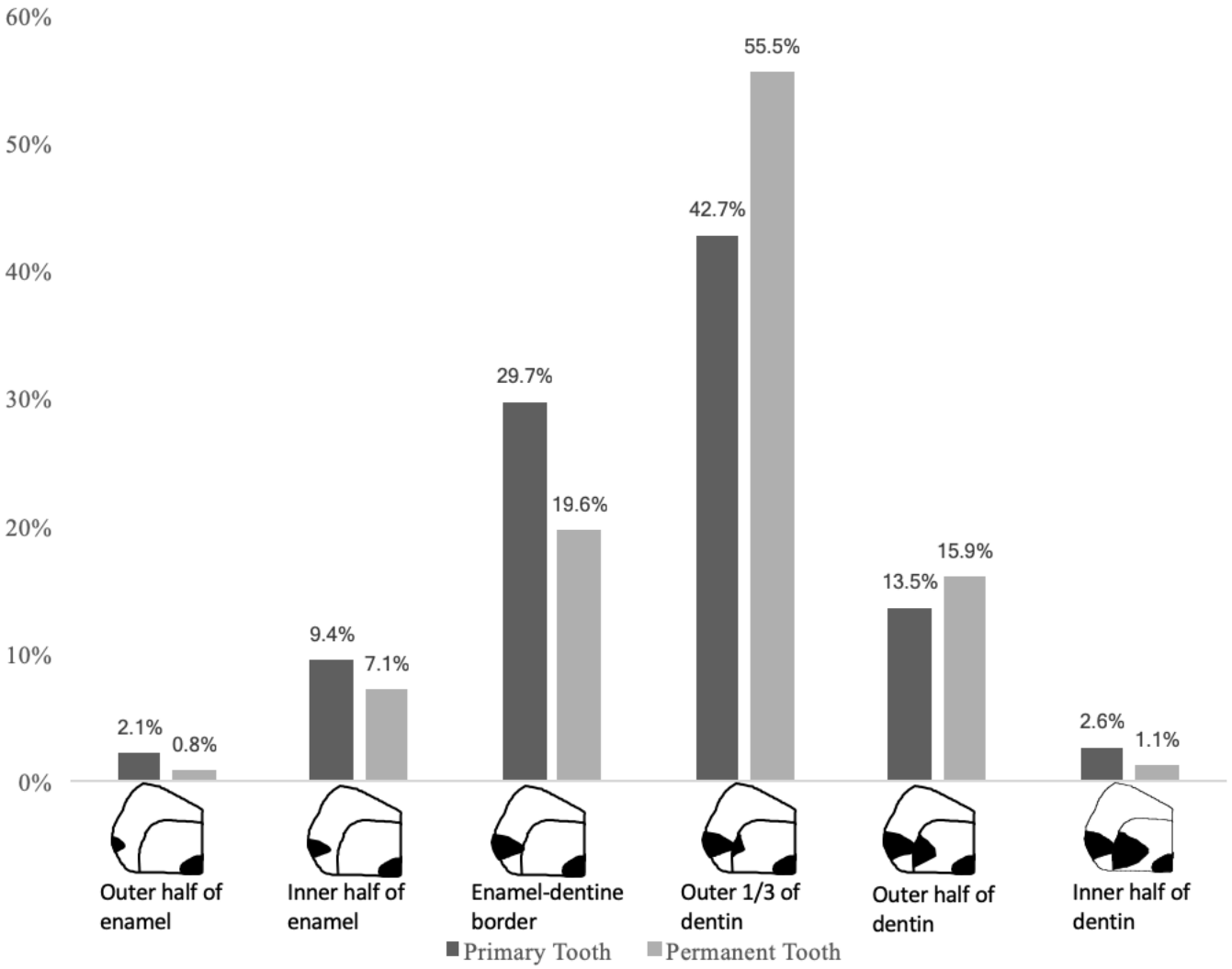


Figure 1: Diagrammatic representation of radiographic image of approximal carious lesions

Which lesion(s) do you think require(s) immediate restorative treatment (cavity preparation and restoration)?

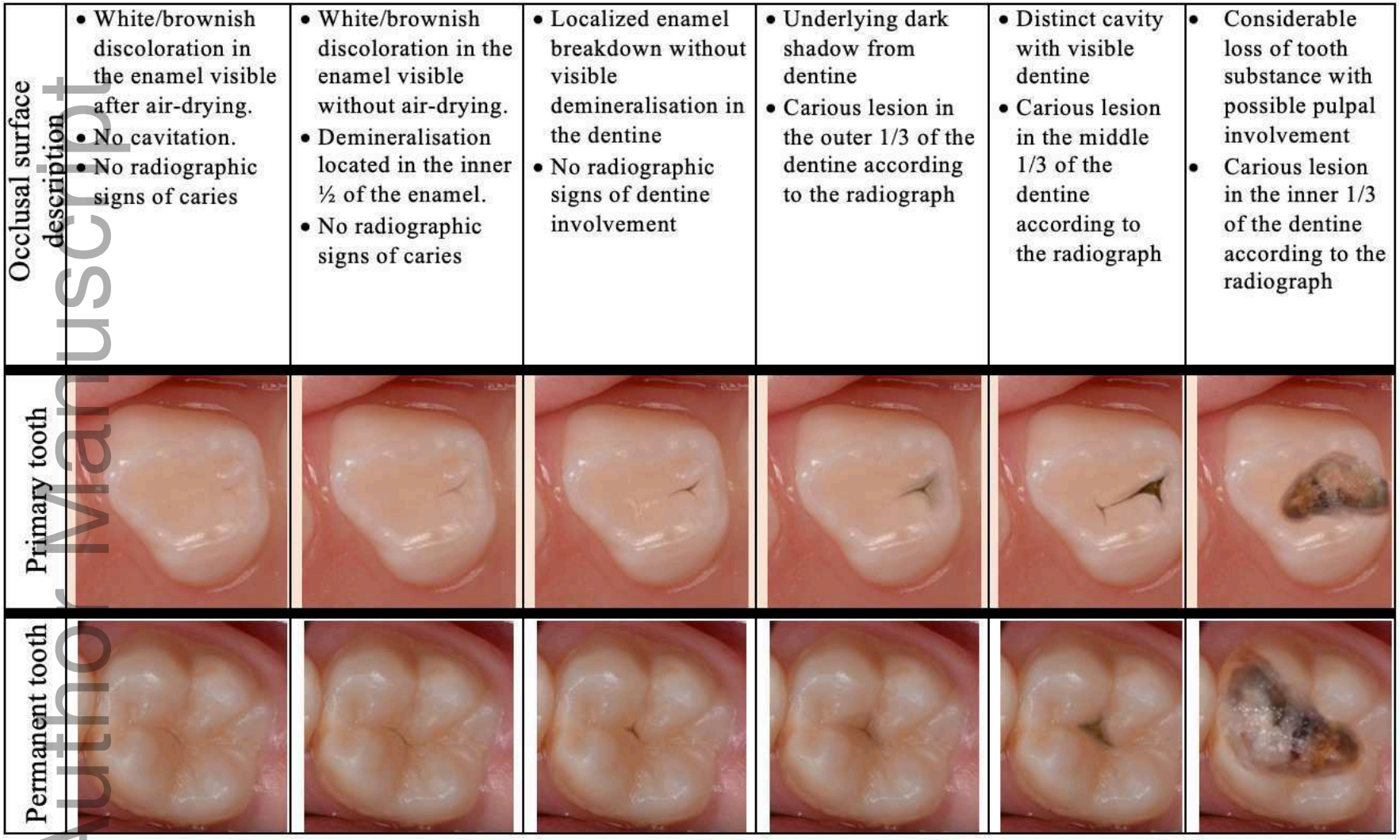


Figure 2: Images and text description provided for earlier stage of restorative intervention in occlusal surfaces

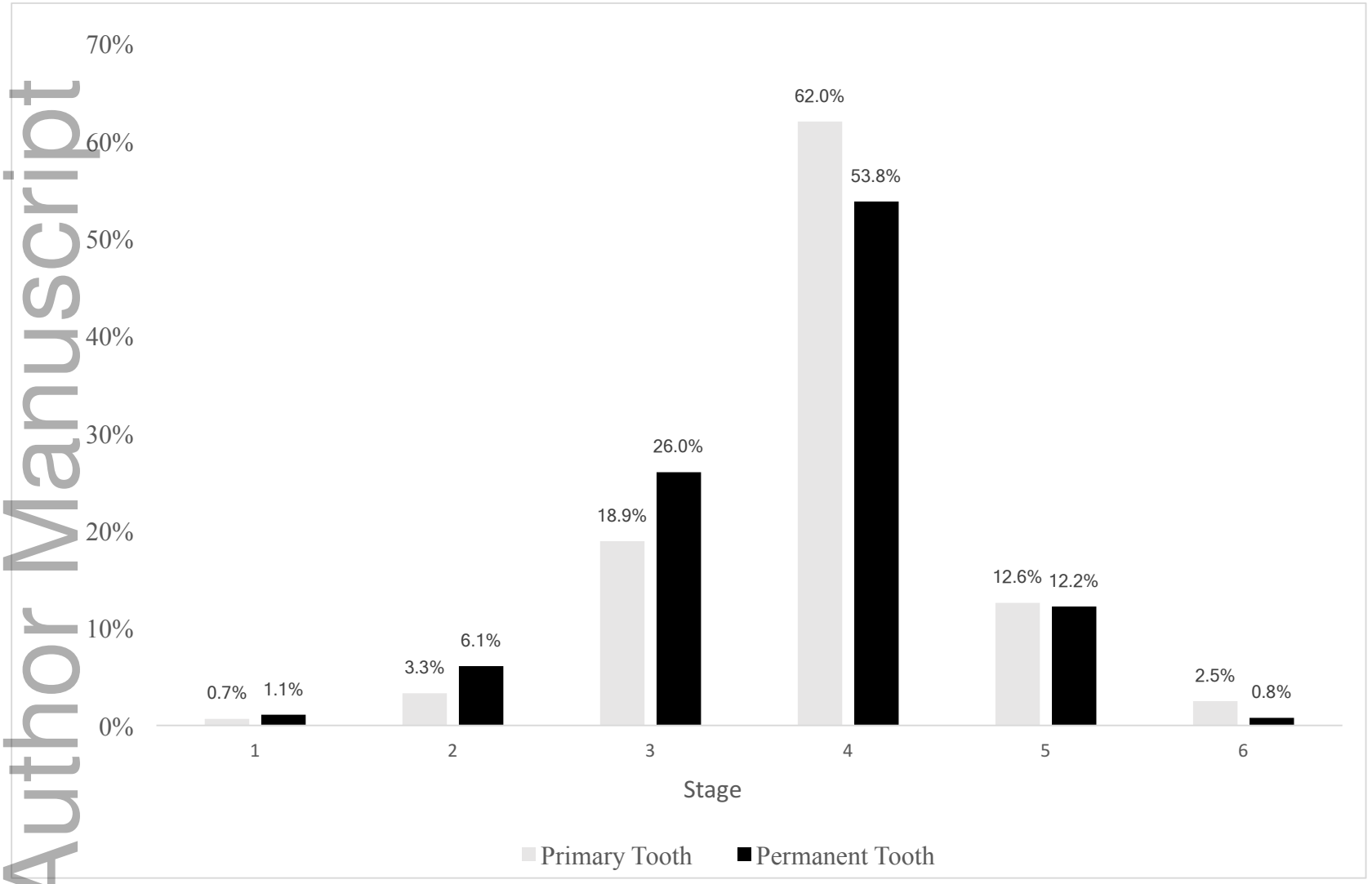


Figure 3. Restorative threshold in occlusal carious lesions on a primary and permanent tooth

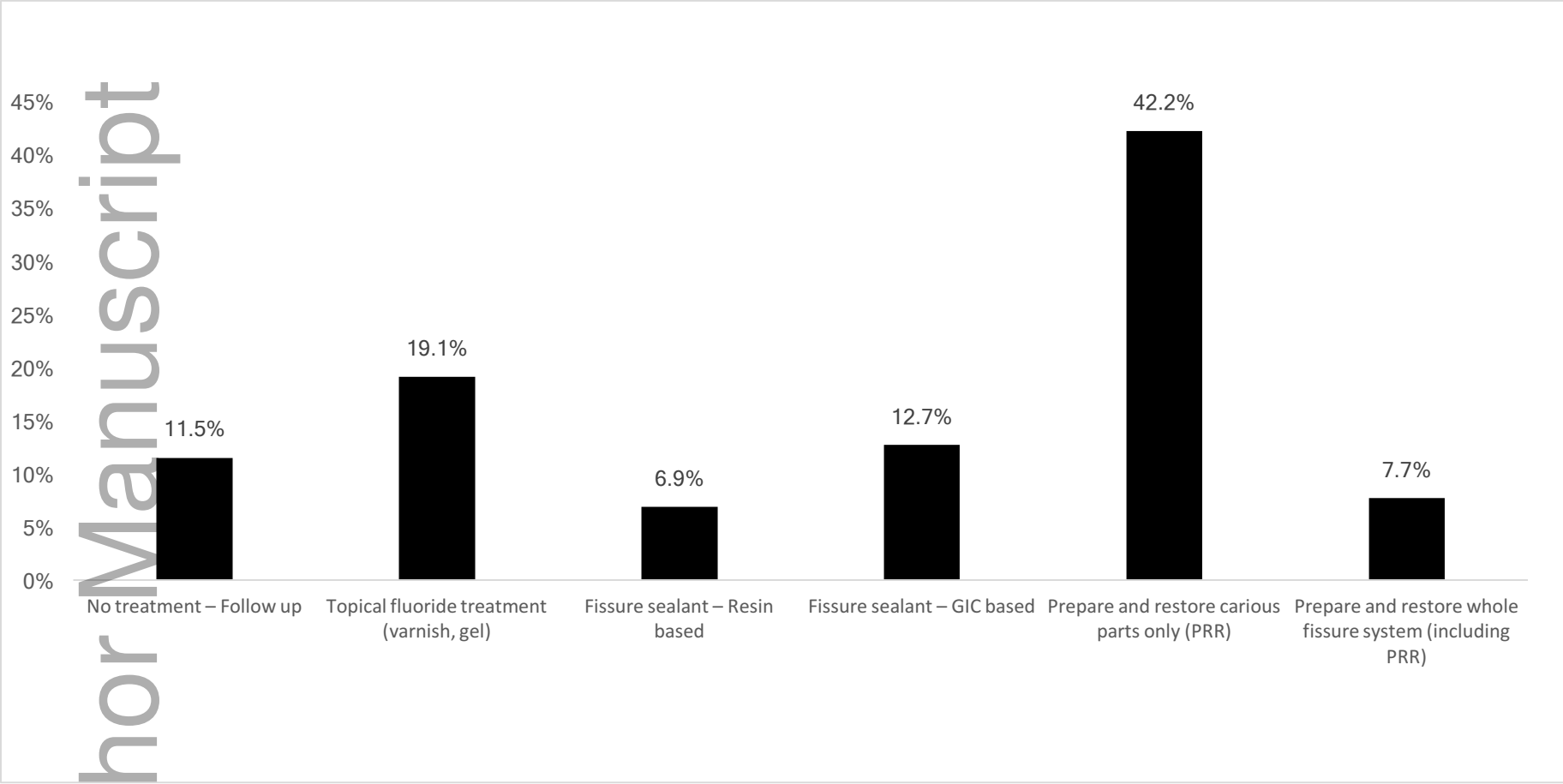


Figure 4. Management of occlusal carious lesions

PRR: Preventive resin restoration