THE USE OF SPACE MAINTAINERS IN THE NORTH YORK PUBLIC DENTAL PROGRAM

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When a primary tooth is lost prematurely, undesirable tooth movements may follow. This movement may result in a loss or reduction of the arch space that will be required by the succeeding tooth (Bayardo 1986; Popovich & Thompson 1988; Eckles & Shulman 1990). Insufficient arch space can result in crowded, rotated, and impacted teeth. The amount of space loss following the premature loss of a deciduous tooth depends on a number of factors including the specific tooth lost, the child's dental age, crowding or spacing of the remaining dentition, occlusion, intercuspation, and the eruption sequence (Popovich & Thompson 1988). To prevent space loss, space maintaining appliances such as crown and loop space maintainers or lingual archwire space maintainers are often advocated. However, opinions vary concerning efficacy of space maintainers, with North Americans practising this procedure much more often than Europeans (Popovich & Thompson 1988).

The present North York Public Health Department Guidelines list 5 factors (parent, patient, clinical, dental, technical) to consider before placing a space maintainer. This paper examines these guidelines and recommends modifications where necessary, with reference to the most recent literature.

Background

The period of time between natural primary tooth exfoliation and the eruption of the succeeding tooth, usually ranges from one week to about 4 months (Nystrom & Peck 1989). Premolars require an average of only 5-6 days to erupt after the primary molar is shed. Maxillary canines and lateral incisors require substantially

more time, over 4 months on average, to erupt after exfoliation of the primary tooth. The natural succession of teeth is fairly quick and therefore artificial space maintainers are not usually required. A general summary of the average age at which a child will lose each primary tooth and the age which the successive permanent tooth will erupt can be seen in Table 1.

Because of trauma, caries, ectopic eruption, or congenital disorders, primary teeth are sometimes missing or extracted prematurely (Ghafari 1986; Eckles & Shulman 1990) resulting in a vacant space in the arch. Spaces that are present for a year or more will often reduce in size (Owen 1971; Ghafari 1986; Eckles & Shulman 1990), leaving insufficient space for the succeeding permanent tooth to erupt correctly. The greatest amount of space closure has been reported to occur after the premature extraction of the maxillary or mandibular primary second molars (Ghafari 1986). Similarly, Northway *et al.* (1984) showed that the greatest amount of space loss was due to mesial movement of the permanent molar rather than distal movement of the canine and that the greatest proportion of space loss occurred within a year of extraction.

The space closure following the premature loss of the primary second molar appears to be the greatest (Owen 1971) and is claimed to be particularly pronounced if the tooth is extracted before the first permanent molar erupts (Johnsen 1980). In this case the first permanent molar may erupt much further forward, partially into the vacant space. This tendency is allegedly more pronounced in the maxilla (Owen 1971; Ghafari 1986).

Table 1. Average age at which each primary tooth is shed and each permanent tooth erupts (lower = mandibular; upper = maxillary). Age ranges have been reduced to means (Colgate-Palmolive).

AGE (years)	PRIMARY TOOTH SHED	PERMANENT TOOTH ERUPTING
6	lower central incisor	
6.5		upper central incisor, upper & lower 1st molar
7	lower lateral incisor	
7.5	upper central incisor	upper central incisor, lower lateral incisor
8	upper lateral incisor	
8.5		upper lateral incisor
9		
9.5	lower canine	
10	lower 1st molar	
10.5	upper 1st & 2nd molar	upper 1st premolar
11	lower 2nd molar	lower 1st & 2nd premolar, upper 2nd premolar
11.5	upper canine	upper canine
12		lower 2nd molar
12.5		upper 2nd molar

On the other hand, crowding, rotation, and impaction can result where there has been no premature loss of deciduous teeth. Ronnerman and Thilander (1978) reported on 124 children with and without early loss and concluded that "early loss of deciduous molars has no general influence on space conditions. Reductions of space, resulting in crowding, is fairly common in children without extractions and

normal development may occur in spite of early extractions. This study shows that this difference occurs because children with lack of space, irrespective of tooth extraction, have shorter narrower jaws, are less prognathic, and have greater mesiodistal tooth width than children without lack of space."

Seipel (1949) also examined the effect that the premature loss of one deciduous molar has on occlusion. Approximately 10 years following tooth extraction, Seipel found an average space loss of only 1.9 ± 0.3mm. In about 70% of the cases the space loss was "fairly insignificant" and only played a minor role in the production of malocclusion.

Popovich and Thompson in a 1974 review for the Dental Health Care Services Research Unit point out that cases in the Burlington Growth Centre with premature loss of deciduous molars had greater space loss variability in the early ages but by age 16 there was no difference between the cases with or without tooth loss. Although the sample size was small, 15 cases with prematurely missing deciduous molars and 15 cases without, their results indicated that space maintainers are not routinely required as a public health measure.

Clinical studies have purported to show that space maintainers preserve the space created when a primary tooth is extracted prematurely. Seipel (1949) studied the effectiveness of space retainers in 72 children who had experienced bilateral premature loss of deciduous molars, but who received a space retainer on one side only; thus, one side served as a control. Seipel found that only 18% of the space maintainers had a positive result (prevented crowding) and 15% had a negative result

(undesirable migration, blocking of development). In 51% of the cases the effect was "questionable" meaning that malocclusion occurred "in spite of the appliance", or no malocclusion occurred on either side. The remaining cases were recorded as having "no safe observations".

Kisling and Hoffding (1979a) report on a clinical trial of 55 children with premature bilateral extraction of deciduous first molars, before the eruption of any permanent molars. Space maintainers were placed on one side only and changes in arch space were monitored for each child until the first four permanent molars had erupted, an average of three years. On the treated side the mean space loss was 0.9mm and on the untreated side the mean space loss was 3.3mm.

However, Kisling and Hoffding (1979) did not present the data in a way that an appropriate analysis of each individual's space loss can be made. Therefore, only a crude approximation of the clinical success rate can be done (Table 2). By calculating the success rate of maintaining space for the space maintainer side and subtracting the success rate of the control side, the net success rate was obtained. If we accept that space loss of 1mm or less is clinical success, the investigators demonstrated a success rate of 49%. If we relax the criteria for clinical success to preserving arch space within 2mm of its original size, the success rate rises to 65%. Beyond 2mm of space loss, the success rate the decreases as more of the control cases are accounted for.

Table 2. Success rate of space maintainers following bilateral extraction of first primary molars (data from Kisling and Hoffding 1978).

Space Loss (mm)	Number of Arches With Space Loss		Cumulative Success Rate
	Treated Side	Untreated Side	
(-)2-0	4	3	2
0-1	28	2	49
1-2	17	8	65
2-3	5	9	58
3-4	1	13	36
4-5	0	12	15
5-6	0	6	4
>6	0	2	0

Kisling and Hoffding (1979a) also included data on another group of 33 children who received 66 spacers, with no control. Results from this group were similar to space loss seen in the group already presented. The total space loss for both sides was as follows: 2 individuals gained space; 21 individuals showed space loss of less than 1mm; 9 showed space loss between 1 and 2 mm; 1 individual showed space loss greater than 2mm.

By considering the tooth itself as the "ideal space maintainer," a recent study by Kurol and Koch (1985) may also be used to investigate space maintenance. This study investigated the effect of extraction versus non-extraction of infraoccluded deciduous molars. Fifteen individuals (mean age 10.1 years, range 8.1-13.0 years) with bilateral infraocclusion of deciduous molars in the mandible were selected and

unilateral extraction was performed on one tooth of each pair. Individuals were examined every 6 months for 1.5 to 4.5 years, and space loss was measured as the diagonal distance between the mesial surface of the first permanent molar and the distal surface of the lateral incisor.

In Kurol and Koch's (1985), the permanent first molar was present in all individuals, which, according to most recommendations in the literature, indicates that space maintenance is not required. After 6 months, the non-extracted side exhibited 6 cases of space loss averaging 0.3mm (SD=0.24, max. loss=1.0mm), and 9 cases showed space gain averaging 0.3 mm (SD=0.38). On the extraction side, 14 of the 15 cases showed space loss averaging 1.4mm (SD=1.00; max. loss=1.9mm) and one case showed a slight gain in space. However, in only two of the space loss cases was a definite space deficiency apparent when the permanent successor erupted. If space loss of less than 2mm is considered a clinical success, these results support a common recommendation in the literature that no space maintenance is necessary if the permanent first molar is present when the deciduous first molar is lost prematurely.

The extent of repair and replacement of soldered (band and loop type) space maintainers should also be considered and has been documented in a few studies. Of the total 121 space maintainers placed by Kisling and Hoffding (1979a), 25% required replacement, 13% required adjustment to relieve "pain or inconvenience," and canine tipping was found in one third of the situations. Hill *et al.* (1975) reported that almost half their study's fixed space maintainers were missing, lost, or

broken over a four year period. Thorton (1982) reported on a number of cases involving space maintainer misuse and failure, and stressed the need for careful patient selection and regular monitoring.

With the advances in composite resins and their bonding materials, bonded space maintainers have also been examined. Swaine and Wright (1976) reported an average failure rate for bonded space maintainers of 30% after six months and concluded that the appliance was clinically unacceptable because its high failure rate. Artun and Marstrander (1983) examined two types of bonded space maintainers for 6 months and reported failure rates of 25% and 11%.

The findings discussed above provide the rational for the different practice patterns seen in North American and European dentists and the dilemma faced by dental program managers. Conclusive evidence on the efficacy of space maintainers appears to be lacking, and even in a potentially efficacious situation the cost, in particular the follow-up cost to the patient and provider, is considerable and also needs to be considered. Early loss of a primary tooth does not always require placement of a space maintainer (Popovich & Thompson 1974; Daly & Walker 1990), and so disagreement exists among practitioners concerning when space maintenance is required (Kisling & Hoffding 1979b; Popovich & Thompson 1988). Current North York Guidelines for the use of space maintainers are grouped into five factors and are listed on the following page (North York Public Health Department, Dental Division Policy and Procedure Manual 1990, p.10.3.125).

Guidelines for use of Space Maintenance

Perform Space Maintenance after considering all of the following:

(1) Parent Factors
- Parents have a positive attitude towards the child's treatment.
- Parents understand the need for regular monitoring of the appliance and are willing to see that the appliance is checked as required.

(2) Patient Factors
- Patient has good oral hygiene.
- Patient obtains maintainer within 3 weeks of extraction.

(3) Clinical Factors
- Cuspal interferences are absent which might otherwise prevent movement of teeth.
- Leeway space is adequate for erupting permanent teeth.
- Wide spacing of deciduous teeth is absent.
- Succeeding permanent tooth is present and is unlikely to emerge within one year.

(4) Dental Factors
- When deciduous first molars are prematurely lost and the above criteria can be met, a space maintainer should be inserted and maintained only and until the first permanent molar emerges.
- When a deciduous second molar is prematurely lost and the above criteria can be met, a space maintainer should be inserted and maintained until the succeeding permanent tooth begins to emerge.

(5) Technical Factors
- band and loop, or crown and loop, for single tooth spaces.
- lingual or palatal arch for multiple tooth spaces.

Purpose

If it is accepted that space maintainers can be efficacious, the disagreement concerning their use makes it necessary to examine North York's Space Maintenance Guidelines. Although the North York Guidelines address many key issues, they are unclear in indicating how the factors should affect the decision making process. For

example, if the parent does not have a positive attitude or if the patient does not have good oral hygiene, should a space maintainer still be placed? All of the North York Factors should be reviewed and modified according to the current best practices found in the literature. Based on variables such as dental age, dentition present, crowding potential, eruption sequence, oral hygiene, and patient (or parent) habits, this report examines when and what type of a space maintainer should be placed.

Methods

To identify references pertaining to space maintenance, its efficacy, and indications for use of space maintainers, a computer-aided literature search was performed. Using MEDLINE and the Medical Subject Heading (MeSH) of space maintenance, the dental literature was searched from 1982 through 1991. A second literature search was also performed for the years of 1989 through 1991 using MEDLINE and combining the MeSH of tooth loss, tooth exfoliation, tooth eruption, preventive orthodontics, or tooth migration. Using the MEDLINE program, the results of searches were limited to articles written in english and involving human subjects. Relevant papers were obtained and reviewed to locate additional references.

Other relevant references were identified through an article by Popovich and Thompson (1988) that was published in a Health and Welfare Canada Manual entitled Preventive Dental Services, Second Edition (1988).

A physical factor also limited the material that was included in this paper. To simplify and quicken the review and writing process, only articles identified by the

computer-aided literature searches that were available from the Faculty of Dentistry Library at the University of Toronto were included.

Articles that discussed the efficacy of space maintenance and indications for the use of space maintainers were included in this paper. Articles that discussed space loss or permanent tooth eruption following premature loss or exfoliation of a primary tooth were also included. However, studies were excluded if: (1) they involved single cases; or (2) involved personal opinions or procedures that were (a) untested clinically or (b) not supported elsewhere in the literature. The last exclusion criterion (2b) was necessary when it was found that little scientific evidence for space maintenance exists in the literature.

The literature search of 1982-1991 using the MeSH of space maintenance identified 51 possible articles and an additional 103 were identified for 1989-1991 using tooth loss, tooth exfoliation, tooth eruption, preventive orthodontics, or tooth migration. However, the vast majority of these articles were reports of individual cases or were reports of "new" clinical procedures that were untested. These studies and studies not pertaining to the use or efficacy of space maintenance, such as studies of orthodontics, were not included in this paper.

Guidelines from the University of Toronto and the University of Western Ontario were also examined. Information on paediatric dentistry, restorative dentistry, preventive dentistry, radiology, and clinics was gathered using teaching manuals and interviews. Further mention of these guidelines is made only when they were found to present opposing views to the findings of the current literature.

It should be noted that the University of Western Ontario's Paediatric Dental Clinic follows guidelines proposed by the American Academy of Pediatric Dentistry (1992).

Using the available scientific evidence practice guidelines for the use of space maintainers were drafted. When scientific evidence was lacking, expert opinion and other existing guidelines were considered.

After drafting the revised guidelines, this literature review and its guidelines were reviewed by two panels. An internal (staff) panel, consisting of three dentists and one hygienist, all of whom work in North York's school-based dental program, initially reviewed the critical appraisal of the literature and the recommended guidelines. Concerns and recommendations of the internal panel were discussed with members of the CDHSRU and necessary changes were made to accommodate those providing the dental services. The document was then reviewed by an external panel of experts consisting of a representative of the Royal College of Dental Surgeons (the 1991-93 President), a representative of the Ontario Dental Association (the 1992-93 President), an epidemiologist, an ethicist, a paedodontist, a general practitioner, and a member of the internal panel. Concerns and recommendations of the external panel were discussed with members of the CDHSRU and any recommended changes were made. The literature review and its guidelines were then finalized after approval by both the internal and external panels.

Findings

Each of the five North York Factors is discussed separately. A final decision by the practitioner however, should not be made until all of the factors have been considered. A final summary of space maintainer use is then presented in the form of a flow chart (Figure 1).

(1) Parent Factors

North York's suggestion that parents have a positive attitude and a solid understanding of the treatment is often discussed in the literature (Beierl & Hune 1974; Stratford 1976; Thorton 1982; Popovich & Thompson 1988; Jordan 1989). It is essential that the parents understand the need for the appliance to be frequently checked (Daly & Walker 1990). When checked, the orthodontic appliance should be passive, not active (Stratford 1976; Wright & Kennedy 1981); dental floss should pass easily between teeth and the wire of a lingual arch (Wright & Kennedy 1981). Numerous studies and reviews support frequent monitoring of space maintainers to remove, repair, or replace the appliances when necessary (Hill *et al.* 1975; Kisling & Hoffding 1979a; Thorton 1982; Artun & Marstrander 1983; Popovich & Thompson 1988; Daly & Walker 1990).

Conclusion: The parent(s)/guardian should be informed that:

a) their child has lost a deciduous tooth prematurely;
b) while most authorities would recommend a space maintainer, scientific evidence is lacking in this area and a space maintainer may not be necessary and may or may not be effective at preserving the space.
c) space maintainers require regular monitoring;
d) the child must maintain adequate oral hygiene (see Patient Factors below);
e) even with regular monitoring and proper oral hygiene, the space maintainers

may break, requiring repair or replacement;

f) a broken space maintainer poses a hazard to the child and will be ineffective.

Following this, the parents should be asked if they would like the dentist to proceed and place a space maintainer. If the parents/gaurdian cannot commit to ensuring that the appliance will receive regular monitoring, it should not be placed.

(2) Patient Factors

A number of studies have addressed the need for good oral hygiene in a patient receiving a space maintainer (Beierl & Hune 1974; Stratford 1976; Popovich & Thompson 1988; Jordan 1989; Daly and Walker 1990). North York also discusses good oral hygiene, but does not address how it should affect the decision to use space maintenance. Practitioners should not place a space maintainer when the patient has poor oral hygiene.

The dentist should also consider patient cooperation before placing a space maintainer. Regular monitoring, as was discussed under Parent Factors, is essential. Loss of a deciduous molar at the age of 7 may require the patient to wear a space maintainer for 4 years, and this may not be a realistic expectation for some children (Stratford 1976).

North York Guidelines state that a space maintainer must be in place within 3 weeks of extraction. Beierl and Hune (1974) and Stratford (1976) agree that the space maintainer should be placed immediately after extraction, but no specific time period within which the appliance should be placed was found in the literature. Space loss may occur anytime after extraction because of natural tooth migration or pressure from erupting teeth that are one or two spaces away from the site.

However, the greatest amount of space loss often occurs within 6 months of extraction (Beierl and Hune 1974; Wright & Kennedy 1981). Stratford (1976) reported that 70% of the space loss occurred within 3 months of extraction. Therefore, quick placement of the appliance should be stressed.

Conclusions: The practitioner should stress the need for the patient to maintain proper oral hygiene. If a space maintainer is prescribed, it should be placed as soon as possible. A deadline for placement, such as 3 weeks, stresses the need for the maintainer to be placed very soon after tooth loss.

(3) Clinical Factors

North York's criterion that "cuspal interferences are absent which might otherwise prevent movement of teeth," appears sensible. If tooth tissue is present that will preserve the space, an artificial space maintainer is not required. An example of this may be an over-erupted maxillary primary second molar that prevents the mandibular permanent first molar from mesial movement (Popovich & Thompson 1988).

Application of North York's second criterion concerning "leeway space" is also logical. If after measuring the space available and/or performing mixed dentition analysis (see Popovich & Thompson 1988), the resultant space is not adequate for the succeeding tooth, maintaining the space a waste of time and materials (Stratford 1976); in this case the space needs to be regained. If crowding is greater than 5mm, Daly and Walker (1990) suggest that space maintenance will not resolve the problem and orthodontic consultation should be sought. Only if the space present is of adequate size would space maintenance be justified.

Wide spacing of deciduous teeth should also be considered when assessing the need for space maintenance. Popovich and Thompson (1988) stated that "children with generalized spacing in the mixed dentition probably will not need space maintainers, particularly after the age of nine years." Crowding tends to result in more rapid space loss than when an excess of space is available and this may influence the practitioners decision about space maintenance (Wright & Kennedy 1981). If the first primary molar is lost after the age of six years in the presence of mild or medium crowding, a space maintainer should be placed (Popovich & Thompson 1988). If wide spacing is present space maintenance is not be needed (Daly & Walker 1990).

If the succeeding tooth will emerge soon after the primary tooth is lost, space maintenance is not necessary (Stratford 1976; Daly & Walker 1990). However, when a primary tooth is lost prematurely, the practitioner must decide whether the space will reduce in size before the succeeding tooth emerges (Beierl & Hune 1974). It has already been mentioned that any space loss will usually occur within six months of extraction (Beierl & Hune 1974; Wright & Kennedy 1981). Therefore, if the succeeding tooth is not expected to emerge within 6 months after the loss of the primary tooth, space maintenance may be needed.

Predicting the time to emergence of the succeeding tooth after the premature loss of a primary tooth is difficult, but estimates may be achieved using root development and dental age. Gron (1962) found that most teeth will erupt when 75% of the root is developed, regardless of the patient's chronological age. A relationship

may also exist between a child's dental age when he/she prematurely losses a tooth and the time required for the succeeding tooth to erupt (Fanning 1963; Posen 1965; Beierl & Hune 1974). Very early extraction, i.e if the child has complete primary dentition or before the age of 6, may result in delayed eruption of the permanent tooth by as much as a year. Later extractions, i.e. if the child is at a later mixed dentition stage or older than 7 years, may accelerate eruption of the succeeding tooth (Posen 1965; Ghafari 1986; Daly & Walker 1990).

The amount of alveolar bone covering the succeeding tooth may also affect the rate of emergence (Popovich & Thompson 1988). A guideline for predicting premolar emergence is that it takes 4-6 months for a tooth to move through one millimetre of bone (Thorton 1982; Daly & Walker 1990). Premature tooth loss may also be accompanied by some bone destruction, which may also accelerate eruption if the succeeding tooth is in a stage of root formation (Ghafari 1986). If the actual tooth is only in early stages of development, eruption may be delayed (Beierl & Hune 1974; Loevey 1989).

To determine the stage of development of unerupted permanent teeth and how much alveolar bone is covering them, a radiograph is necessary (Wright & Kennedy 1981; Popovich & Thompson 1988). A radiograph may also reveal a need for further orthodontic work in the near future and so a space maintainer at this time would not be a good use of resources. Beierl and Hune (1974) suggested that a periapical radiograph, not a bitewing radiograph is necessary to make a proper assessment of the situation.

Conclusion: A space maintainer should not be placed if: (a) cuspal interferences are present that may prevent tooth movement; (b) the present space is not adequate for the succeeding tooth; (c) wide spacing of the deciduous teeth is present; (d) eruption of the succeeding permanent tooth is likely to occur 'soon' (using dental age and/or root development of the succeeding tooth); (e) the patient may need further orthodontic work in the future.

(4) Dental Factors

The North York Guidelines state that the loss of the first or second primary molar is reason for using space maintenance. Other studies have also used these criteria (e.g. Beierl & Hune 1974; Ghafari 1986; Popovich & Thompson 1988), but with slight modifications. Using these studies, particularly Popovich and Thompson (1988), the criteria regarding primary molar loss will be summarized.

If the first primary molar is lost a space maintainer should be considered unless both the permanent first molar and the permanent lateral incisor have already erupted. If the permanent first molar and lateral incisor are present, space maintenance is probably not needed, provided there is good interdigitating and occlusion (class I), without crowding (Popovich & Thompson 1988).

If a child with "close fit" (no crowding or spacing) loses the primary second molar or both the primary first and second molars a space maintainer should be considered (Popovich & Thompson 1988). The University of Toronto suggests that space maintenance is not necessary in this instance if both the first and second permanent molars are present. However, this would appear to be a rare occurrence considering when primary molars are naturally shed and permanent molars naturally erupt (see Table 1).

(5) Technical Factors

The North York Guidelines and many authors (Beierl and Hune 1974; Wright and Kennedy 1981; Ghafari 1986) state that a band and loop appliance should be used for single spaces resulting from the loss of a primary molar. If the abutment tooth is highly carious, exhibits marked hypoplasia, or has been pulpotomized, a crown and loop should be used instead of a band and loop (Wright & Kennedy 1981).

For maintaining multiple spaces, North York standards recommend the use of a lingual or palatal arch, which is consistent with Wright and Kennedy (1981), and Ghafari (1986). Lingual arch wires should be used for maintaining spaces in the mandibular arch, and palatal arch wires should be used for maxillary spaces (Wright & Kennedy 1981).

If a child loses the primary second molar before the eruption of the first permanent molar, an intra-alveolar appliance or distal shoe may be required (Beierl & Hune 1974; Wright & Kennedy 1981; Ghafari 1986; Daly & Walker 1990). This represents one of the most difficult space management problems (Thorton 1982; Daly & Walker 1990) and requires great care when being positioned (Wright & Kennedy 1981; Daly & Walker 1990) . Because of its somewhat fragile nature and the difficulty of proper placement, regular monitoring is very important. Part of these devices is often submerged in the gingival tissue and so they should not be placed in children with medical conditions such as blood dyscrasia, congenital heart defects, history of rheumatic fever, diabetes, etc. (Ghafari 1986; Daly & Walker 1990).

Removable space maintainers are recommended by the American Academy of

Paediatric Dentistry (1992) and Beierl and Hune (1974) suggest their use for preserving multiple tooth spaces. However, fixed orthodontic appliances have been shown to be more effective (Tang and Wei 1990) and require less chair time (Popovich & Thompson 1975). Fixed appliances also require less patient cooperation and have greater appliance integrity than removable appliances (Wright & Kennedy 1981). Fixed appliances do require an abutment tooth with good root area, but their use is preferable in patients of "uncertain cooperation" (Beierl & Hune 1974).

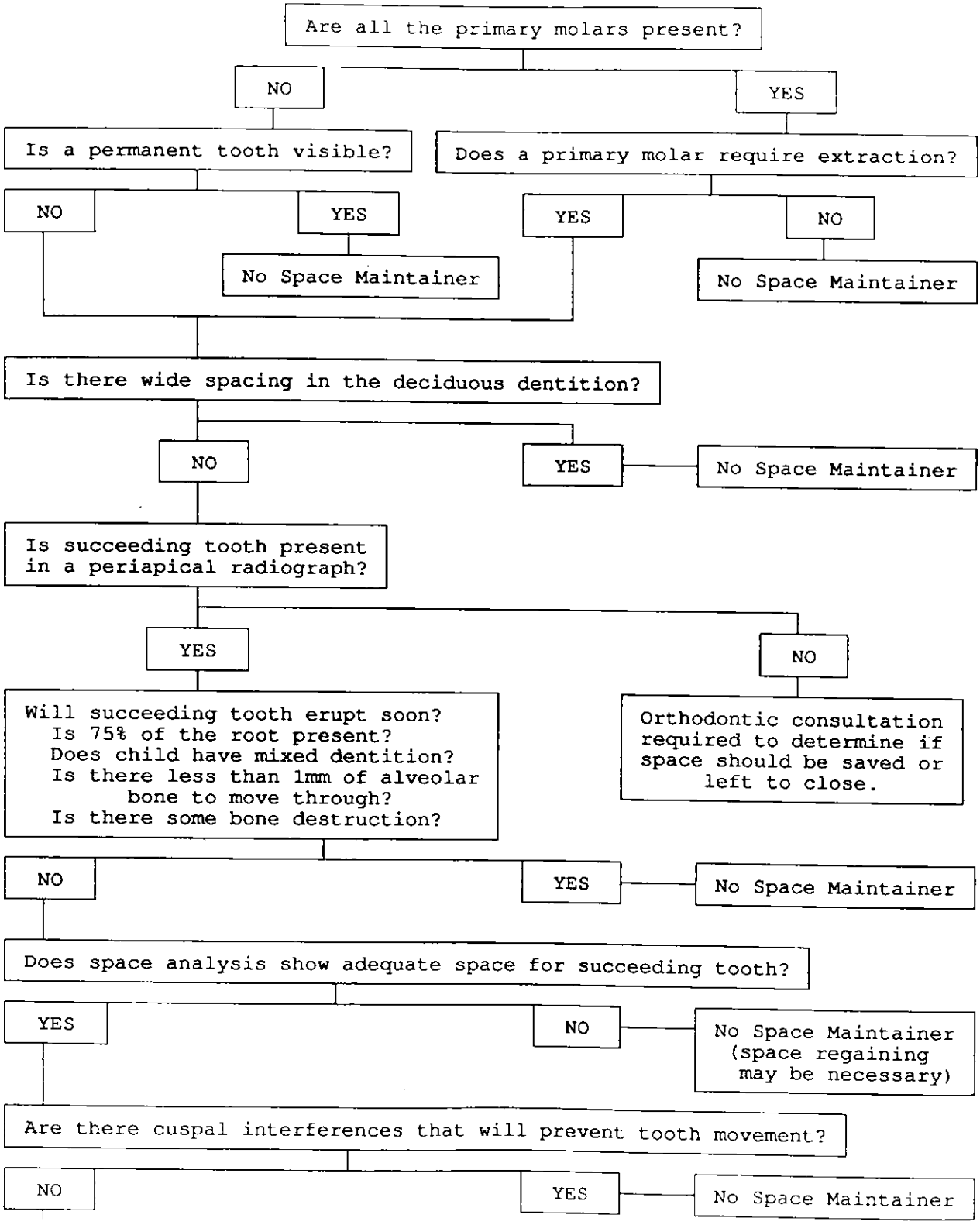
Wright and Kennedy (1981) do identify some situations where a removable appliance may be favourable to fixed appliances. If many teeth have been lost so that few teeth remain to support a fixed appliance, or if multiple teeth have been lost and permanent molars and incisors are incompletely erupted, a removable appliance may be the most appropriate. However, given the likely history, a practitioner would have to carefully assess the expected compliance in deciding on the prognosis.

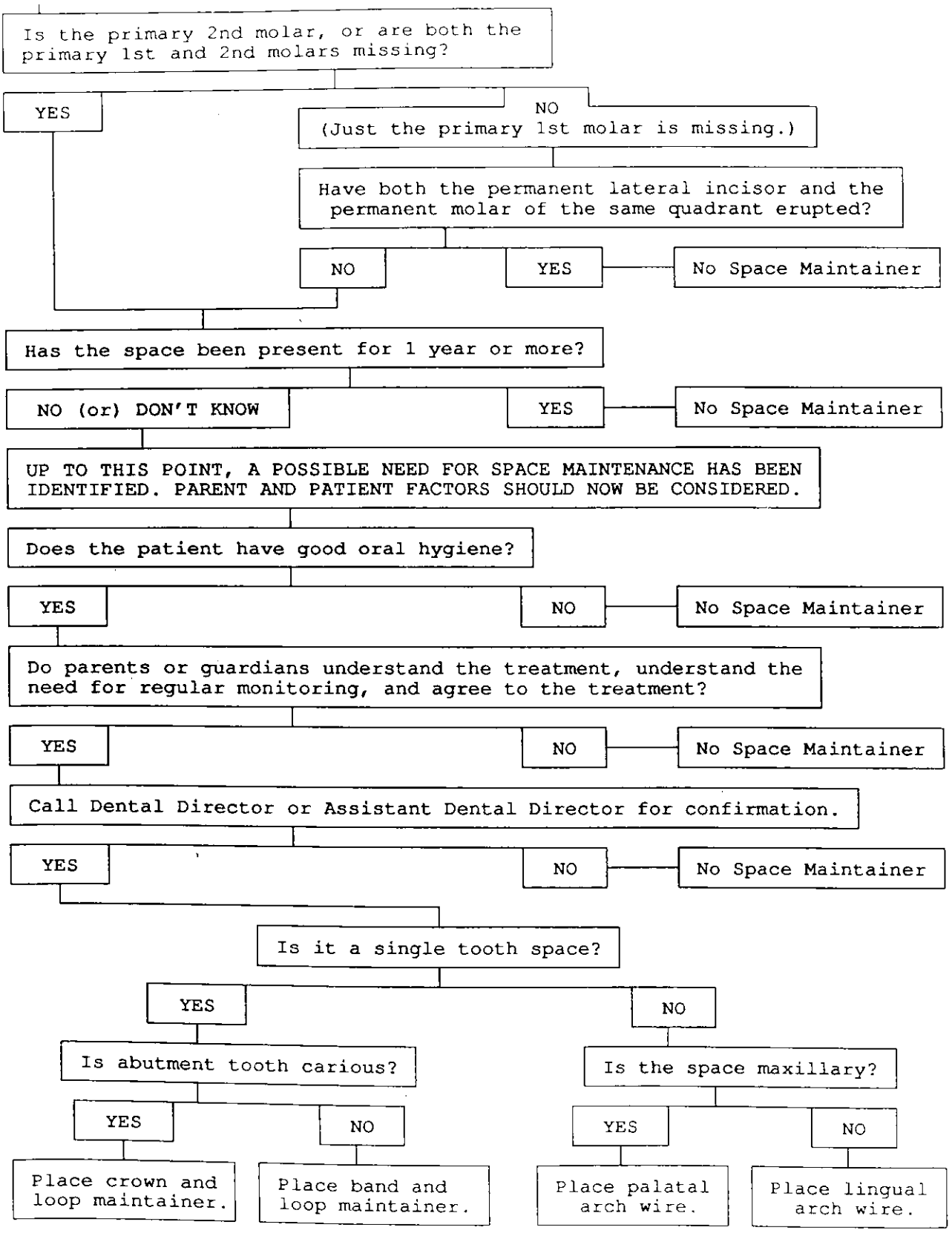
General Summary

Many factors must be considered before placing a space maintainer. To summarize the information already presented, a step by step decision making process may be used. Figure 1 shows a decision making flow chart that follows the logic of establishing a need for a space maintainer using dental and clinical variables, followed by further considerations, such as patient behaviour. The need for regular and frequent monitoring of the appliance cannot be stressed enough to those involved in the decision making process.

Note: Figure 1 is designed to be a general guide for space maintenance but should be used critically and cautiously. Some of the criteria are listed in an "all or none" fashion but are not often encountered in this way (e.g. Does the child have good oral hygiene? Is there wide spacing of deciduous teeth?). The care giver should also include their own professional judgement and remember that the decision diagram is not the "final word." The care giver may want to consider some other factors that are not included in the diagram, such as the need for future orthodontic treatment or digit sucking. The care giver may also feel that certain 'failings', such poor oral hygiene, should be overlooked because of the patient's high need for treatment.

FIGURE 1. Decision making flow chart for use of space maintainers.




Is the primary 2nd molar, or are both the primary 1st and 2nd molars missing?
YES
NO
(Just the primary 1st molar is missing.)
Have both the permanent lateral incisor and the permanent molar of the same quadrant erupted?
NO
YES
No Space Maintainer
Has the space been present for 1 year or more?
NO (or) DON'T KNOW
YES
No Space Maintainer
UP TO THIS POINT, A POSSIBLE NEED FOR SPACE MAINTENANCE HAS BEEN IDENTIFIED. PARENT AND PATIENT FACTORS SHOULD NOW BE CONSIDERED.
Does the patient have good oral hygiene?
YES
NO
No Space Maintainer
Do parents or guardians understand the treatment, understand the need for regular monitoring, and agree to the treatment?
YES
NO
No Space Maintainer
Call Dental Director or Assistant Dental Director for confirmation.
YES
NO
No Space Maintainer
Is it a single tooth space?
YES
NO
Is abutment tooth carious?
Is the space maxillary?
YES
NO
YES
NO
Place crown and loop maintainer.
Place band and loop maintainer.
Place palatal arch wire.
Place lingual arch wire.

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