Space Maintenance – Indications and Illustrated Cases

Abstract: Space maintenance should form an integral part of paediatric dentistry and interceptive orthodontics. It has two main aims: the maintenance of space for a future prosthesis, and the limitation of localized crowding. There are many varieties of space maintainer, broadly divided into two groups; fixed or removable. The design and use depend upon the number, size and position of the teeth missing, the teeth present in the mouth and the dental developmental stage the child has reached. Careful patient selection, timing of treatment and regular review is necessary to maximize the benefits. Clinical cases are presented illustrating the use of various space maintainers.

Clinical Relevance: Space maintenance is an important part of preventive and interceptive orthodontics and should always at least be considered by the general dental practitioner in situations requiring extraction of deciduous or permanent teeth, or where traumatic loss of permanent incisors has occurred.

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Space maintainers form an important part of preventive and interceptive orthodontics, often preventing the development of a malocclusion or reducing its severity.1,2 There are many situations in which space maintainers can be beneficial where preservation of arch length is vital. In the deciduous dentition, premature loss of a deciduous canine or molar may allow drift of the adjacent teeth, with resultant displacement of permanent teeth and centreline disturbance.3 Obviously, in a spaced deciduous dentition this is less likely. In the permanent dentition, space maintainers can be used in cases of delayed eruption, congenitally missing permanent teeth, or tooth loss due to caries, pulp pathology or trauma.

Little scientific evidence exists regarding the efficacy of space maintainers; however, current clinical opinion and available research data encourage their use. There is a need for more research in the area.

The best space maintainer is, undeniably, the tooth itself, but if, for various reasons of pathology or trauma, the natural tooth is unable to perform this function, then a removable or fixed space maintainer can be used to preserve the arch length.

<table>
<thead>
<tr>
<th>Fixed</th>
<th>Removable</th>
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<tr>
<td>Natural tooth</td>
<td>Partial denture</td>
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<td>Bonded avulsed tooth</td>
<td>Upper removable appliance</td>
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<tr>
<td>Stainless steel tube on archwire</td>
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<td>Stainless steel crown and loop</td>
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<td>Band and loop</td>
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<td>Transpalatal arch</td>
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<td>Lingual arch</td>
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Figure 1. Classification of space maintainers.

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this is not an option, alternatives can be classified into removable or fixed (Figure 1). Fixed space maintainers may include bonding of the crown of a recently avulsed incisor, a stainless steel orthodontic band and soldered wire loop, stainless steel crown and loop, lower lingual arch, and transpalatal arch with or without a Nance button. Removable space maintainers, such as partial dentures, can be useful whilst waiting for growth to cease in cases where anterior permanent teeth are missing. Upper removable appliances with stops can prevent unfavourable drift of adjacent teeth and, if necessary, springs can be added to reopen space or move teeth to more favourable positions.

There are five questions to consider before a space maintainer is provided:

- Is the occlusion likely to worsen as a direct result of the tooth loss?
- Will the malocclusion increase in severity if space maintenance is not provided?
- Is spontaneous space loss likely and will subsequent treatment become more complicated?
- Will space maintenance possibly reduce the need for extractions required for orthodontic purposes?
- Is there some aesthetic impairment which a space maintainer might improve?

If the answer to any of the above is ‘yes’, a space maintainer should be seriously considered.

The amount of crowding within the arches can be assessed using a formal space analysis, such as The Royal London Space Planning.* once
the permanent teeth have erupted or, alternatively, predicted using one of the many mixed dentition analyses, such as those described by Hixon and Oldfather.\(^1\)

Radiographic examination revealed a shortage of space in the upper arch and evidence of development of third molars in all four quadrants. The bifurcation area of the mandibular second molars was showing signs of calcification (Figure 2f).

If the carious upper first molars were extracted at this stage, it is likely that there would be spontaneous space closure with spontaneous mesial movement of the unerupted second molars, and no space gain ultimately to correct the malocclusion. The maxillary first permanent molars were therefore the perfect ‘space maintainer’ to hold back the second molars until they had fully erupted. At this stage, a Nance palatal arch can be placed connecting the two second molars, the first molars can be extracted and almost all the extraction space can be used in correcting the malocclusion (Figure 2 g-j). It is important to cover a large area of the hard palate with acrylic to gain maximum effect from the Nance arch.

In the lower arch, however, because there was potentially excess space, it was decided to extract mandibular first permanent molars as soon as possible to maximize the chance of spontaneous space closure. Had these extractions not been carried out in this timely fashion, the lower second molars would have fully erupted behind the first molars and the time consuming space closure in this case would have added 6–9 months to the total treatment time.\(^9\)

Case 2

A 14-year-old girl was referred

Tanaka and Johnston,\(^6\) or Moyers.\(^7\) Other factors to consider are the stage of dental development of the patient, the current level of oral hygiene, and likelihood of co-operation with treatment.

The decision to fit a space maintainer after traumatic loss of a tooth or enforced extraction must be arrived at by balancing the potential benefits of intervention against the harm caused by plaque accumulation and increased susceptibility to caries that the appliance may cause.\(^2\) Most space loss occurs in the first few months following tooth loss, therefore it is important to place the appliance as soon as possible after extraction.\(^1,2,8\)

The following cases illustrate the use of four common types of space maintainer:

Case 1

A 9-year-old girl was referred by her general dental practitioner to the orthodontic department regarding her increased overjet and anterior open bite. The patient presented with a Class II division 1 incisor relationship on a Class II skeletal base, with increased overjet, anterior open bite, and crowding present in the maxillary arch (Figure 2 a-c). She was in the mixed dentition with caries present in all four first permanent molars and maxillary right first and second deciduous molars. Mandibular deciduous second molars had been extracted previously owing to caries, with mesial migration of the mandibular first permanent molars evident (Figure 2 d-e).

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Case 2

A 14-year-old girl was referred
by her general dental practitioner to the orthodontic department for consideration of her unerupted left mandibular second premolar. The patient presented with a Class III incisor relationship on a Class III skeletal base. She had a well aligned mandibular arch and radiographic examination revealed an unerupted permanent successor with an enlarged follicle (Figure 3 a, b). There is always the tendency for mesial drift of posterior teeth and, in this case, any space loss in the lower would be undesirable.

The retained tooth was extracted under local anaesthetic and a simple fixed space maintainer was provided in the lower left quadrant to maintain space for the unerupted second premolar (Figure 3c). One year later, the premolar had spontaneously erupted into the space and the slight excess of space was used during the treatment with fixed appliances to provide as much correction as possible for the Class III incisor relationship.

Case 3
An 11-year-old boy was referred to the orthodontic department regarding his congenitally absent maxillary lateral incisors. The patient presented with a Class II division 1 incisor relationship on a Class II skeletal base. He was in the mixed dentition with spacing in the maxillary arch.

A Twin Block functional appliance was used, followed by fixed appliances to optimize the spaces available for prosthetic replacement of the teeth (Figure 4a). In this case, aesthetics was a major concern and therefore prosthetic incisors were added to the archwire during treatment. Following completion of treatment, Essix retainers were provided, incorporating two prosthetic lateral incisors (Figure 4b). It is absolutely essential to maintain the space accurately for the prosthetic lateral incisors and, once growth has ceased, the spaces can be finally restored with implant-retained prostheses.

Case 4
An 11-year-old boy avulsed his upper right central incisor in a cricketing accident. There had been recent orthodontic extractions of the upper and lower first premolars and the canines were erupting in a reasonable position (Figure 5 a-c). Space maintenance in the upper central incisor area was essential to prevent the relief of crowding by the upper left incisors shifting to the right. In this case, stainless steel tubing on the fixed appliance was used as the space maintainer (Figure 6). The final result demonstrates a Class I canine and molar relationship with sufficient space for an upper right central incisor (Figure 7 a, b). This space was maintained with an upper Hawley retainer incorporating a stop mesial to the upper right lateral incisor and a prosthetic upper right central incisor (Figure 8).

Discussion
The four cases discussed above illustrate the use of various space maintainers in different situations. The first case involved retaining the natural, albeit unhealthy, first molars as ‘natural’ space maintainers to prevent spontaneous mesial movement of the second molars into extraction sockets. This was followed with the use of a palatal arch with Nance button as a second space maintainer. Palatal arches, with or without Nance buttons, are often indicated where the inevitable forward movement of two upper molars is undesirable. Once cemented, they do not place great demands upon patient co-operation other than a good diet and adequate oral hygiene. They must be monitored
frequently as, if not well made, can cause mucosal irritation. By temporarily
frequently as, if not well made, can cause mucosal irritation. By temporarily
reduce the crowding, correct the overjet and align the arch. In addition, some space
reduce the crowding, correct the overjet and align the arch. In addition, some space
would be provided to allow eventual eruption of the upper third molars.
would be provided to allow eventual eruption of the upper third molars.
The second case demonstrated the use of a simple band and loop space
The second case demonstrated the use of a simple band and loop space
maintainer. These are easily fabricated by the technician and very well accepted by
maintainer. These are easily fabricated by the technician and very well accepted by
patients. There is little interference with the occlusion as they only involve one
tooth and they are not dependent upon patient co-operation. They allow maximum
octoth and they are not dependent upon patient co-operation. They allow maximum
use of the space available, in this case gaining 1.5–2 mm of ‘E’ space which could
use of the space available, in this case gaining 1.5–2 mm of ‘E’ space which could
help with the Class III incisors. A further advantage is that they can be left in place
help with the Class III incisors. A further advantage is that they can be left in place
for prolonged periods where necessary without major risk of damage to the
dentition or soft tissues.
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dentition or soft tissues.
The third case illustrates the use of two types of removable space
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maintainer. Following completion of orthodontic treatment, a period of
maintainer. Following completion of orthodontic treatment, a period of
retention is advised. If an Essix retainer is to be worn and the patient has missing
retention is advised. If an Essix retainer is to be worn and the patient has missing
anterior teeth, as in this case, it is a simple matter to incorporate prosthetic teeth
anterior teeth, as in this case, it is a simple matter to incorporate prosthetic teeth
which would also improve appearance and therefore encourage compliance
which would also improve appearance and therefore encourage compliance
with the retention regime. If an accurately fitting space maintainer is not used in
with the retention regime. If an accurately fitting space maintainer is not used in
these cases, anterior tooth movement can result in space loss. This can result in
these cases, anterior tooth movement can result in space loss. This can result in
a need for further treatment time while space is recreated to perfect the root and
crown positions for subsequent implant placement. Upper removable appliances
root and crown positions for subsequent implant placement. Upper removable appliances
incorporating prosthetic teeth can restore both aesthetics and function and only
incorporating prosthetic teeth can restore both aesthetics and function and only
require an upper alginate impression. One potential disadvantage is that these
require an upper alginate impression. One potential disadvantage is that these
are removable and therefore require patient co-operation, with almost full-
are removable and therefore require patient co-operation, with almost full-
time wear, for success of treatment. It is sometimes advisable to use a bonded
time wear, for success of treatment. It is sometimes advisable to use a bonded
retainer on upper incisors in addition to the removable retainer which restores
retainer on upper incisors in addition to the removable retainer which restores
aesthetics.
aesthetics.
The final case shows how a fixed orthodontic appliance can be used
to regain and maintain space during orthodontic treatment. The space is finally
to regain and maintain space during orthodontic treatment. The space is finally
held with a modified Hawley retainer prior held with a modified Hawley retainer prior
to definitive restoration placement in the to definitive restoration placement in the
upper right central incisor area.
upper right central incisor area.
Complications with space maintainers include the following:
Complications with space maintainers include the following:
- Breakage;
- Breakage;
- Failure of cementation of bands or solder failure;
- Failure of cementation of bands or solder failure;
- Pain or discomfort on placement;
- Pain or discomfort on placement;
- Caries;
- Caries;
- Soft tissue overgrowth; and
- Soft tissue overgrowth; and
- Interference, with the eruption of permanent teeth if incorrectly made. 10
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Six monthly review following the insertion of a space maintainer is recommended to
Six monthly review following the insertion of a space maintainer is recommended to
intercept and minimize the deleterious effects of the aforementioned conditions.
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A check should be made as to when the use of the space maintainer should be
A check should be made as to when the use of the space maintainer should be
discontinued. Careful use and timing of space maintainers will make a significant
discontinued. Careful use and timing of space maintainers will make a significant
difference to patients in general dental practice. If there is any doubt at all as to
difference to patients in general dental practice. If there is any doubt at all as to
whether a space maintainer will benefit the patient, then referral to a specialist
whether a space maintainer will benefit the patient, then referral to a specialist
orthodontist or local hospital consultant is highly recommended to allow full
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and comprehensive assessment of the and comprehensive assessment of the
malocclusion.
malocclusion.

Conclusion

Space maintenance should always at least be considered by the
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general dental practitioner whenever premature extraction of deciduous
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teeth or enforced loss or extraction of
teeth or enforced loss or extraction of
permanent teeth occurs. A number of
permanent teeth occurs. A number of
fixed and removable space maintainers
fixed and removable space maintainers
are available and judicious use of these
are available and judicious use of these
in the appropriate cases will improve the
in the appropriate cases will improve the
quality of results achieved for this group of
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patients.
patients.

References