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Early Class II treatment

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ABSTRACT

The treatment of children presenting with a Class II division I malocclusion involves one of two approaches. The first provides treatment in two phases; one of intervention during the mixed dentition (phase I) followed by a second definitive course of appliance treatment in early adolescence (phase II). The second approach involves providing a single course of comprehensive therapy during adolescence. The debate for and against early treatment is discussed alongside key, clinically relevant evidence related to Class II division I malocclusions.

Keywords: Class II, two-phase, early treatment.

Abbreviations and acronyms: NNT = numbers needed to treat; PAR = Peer Assessment Rating; CI = confidence interval.

INTRODUCTION

Class II malocclusions affect nearly 25% of 12-year-olds in the United Kingdom[1] and 15% of 12 to 15-year-olds in the United States,[2] making it one of the more commonly-treated malocclusions in the Western world.

In recent decades, the provision of treatment when children are 7 to 11 years old with the aim of intercepting a Class II division I malocclusion has gained a level of popularity particularly in parts of Europe and the United States. Treatment may involve initial intervention during the mixed dentition (phase I) which is usually followed by a second course of appliance therapy during early adolescence (phase II). The proponents of 2-phase treatment suggest that there are significant benefits to early intervention including:

- The normalisation of the skeletal pattern and growth
- A reduction of the length of any subsequent phase II treatment
- Future courses of orthodontic treatment are simpler and quicker
- The need for future extraction of permanent teeth is reduced
- The chance of traumatic dental injuries is also significantly reduced

Mixed-dentition treatment

Typical phase I treatment might involve the use of fixed appliances when only the permanent incisors and first molars have erupted. Headgear is fitted to bands on the first molar teeth to correct the skeletal discrepancy and to achieve a class I molar relationship. Alternatively, a functional appliance may be used at this early stage. An additional aim might be to achieve a normal overjet and overbite at this time, as well as aligning the incisors. During this early phase, an attempt might also be made to manage the arch length in the presence of crowding, thereby securing space in the arches for the developing canine and premolar teeth, via the use of palatal and lingual arches.

Facial profile considerations drive early orthodontic/orthopaedic treatment, and claims are also made that the elimination of abnormal function in the perioral muscles is possible.[3]

The early treatment is initially planned to last for as short a time as possible after which a period of 'retention' is usually required. This might involve the continued wear of a maxillary removable appliance plus night-time headgear, if there is a risk of 'relapse' of the achieved Class II correction. If lingual arches have been used to maintain arch length, they are often maintained during this period to ensure mesial drift of the molars does not occur as the deciduous molars

exfoliate. It is also believed that a lingual arch will help maintain the alignment of the lower incisors. In many cases, the patient is seen every 10-12 weeks until the permanent dentition has fully erupted, at which time a second comprehensive phase of treatment may commence to address any residual malocclusion traits.

Adolescent treatment of Class II division I

A more conventional approach which is the mainstay of prescribed treatment, involves providing a single course of comprehensive care for a child in early adolescence when the late mixed dentition or permanent dentition is present.

In the UK and in Australia, the appliance of choice in the majority of Class II division I cases in the Twin Block appliance. Treatment involves the placement of the functional appliance at the earliest opportunity usually when the second deciduous molars are about to exfoliate and, in most cases, when the full permanent dentition is established, which is about 11-12 years old in girls and 12-13 years old in boys.

It is typically requested that the Twin Blocks are worn 'full time' and removed only for cleaning, for contact sports and if the patients really cannot eat with the appliance in place. With a cooperative patient, it is expected that a 1.5-2 mm overjet reduction per visit is achieved and, after 4-5 months, the Twin Blocks are reactivated by adding predetermined self-curing acrylic buttons to the upper block.

Twin Block treatment usually lasts 9-12 months, at the end of which there should be a 0mm overbite and overjet, sagittal over correction of the buccal segments and bilateral, buccal open bites.

Once sagittal correction has been achieved, the patient usually continues into upper and lower fixed appliances to align the teeth, settle the buccal open bites and detail the occlusion. Extractions may be needed at this stage to create space for the relief of crowding. To facilitate the transition to fixed appliances, an upper removable appliance may be fitted with a steep, deep inclined anterior bite plane. This functions to maintain the sagittal correction achieved during Twin Block wear and is worn full time except when eating. The bite plane is continued during the alignment stage of fixed appliance therapy but is discontinued once Class II elastic traction is started, upon the insertion of rigid stainless steel wires.

Fixed appliance therapy is usually continued until the malocclusion is fully treated and encompasses an overall treatment duration of 24 to 30 months.

Clinicians advocating a single phase of treatment argue that this approach:

- decreases total treatment time
- is carried out at the optimum time which coincides with the adolescent growth spurt
- decreases the patients' total time off of school
- reduces the parents/carers' time off work
- reduces the total burden of patient cooperation
- avoids the difficulties of retention between phase I and phase II
- reduces the financial burden of treatment
- reduces the unavoidable physiological consequences of a prolonged course of treatment including enamel demineralisation and root resorption

In the remainder of this article the scientific evidence for the benefits of early treatment versus later treatment for Class II division I malocclusions, are examined.

IS THERE ANY EVIDENCE TO PROVE THE BENEFITS OF EARLY TREATMENT?

Overjet, ANB, PAR score and self-concept

Proponents of early treatment argue that intervention reduces the need for, and complexity of, later orthodontic care. It has also been suggested that the approach results in a more favourable occlusal result and skeletal correction, along with psychological benefits.

The highest level of evidence in evidence-based dentistry is a systematic review and ultimately a meta-analysis of the available data. A Cochrane Review[4] on the early treatment of Class II/I malocclusions will therefore form the basis of discussion.

Three randomised clinical trials on the early treatment of Class II division I malocclusion were included in the meta-analysis:

The Florida study: a randomised parallel group study conducted in the University of Florida over 10 years.[5–8] The mean age at commencement was 9.6 years and a Class II malocclusion was defined as having at least a bilateral 1/2 cusp Class II molar relationship or one side presenting with less than 1/2 cusp Class II relationship if the other side was greater than 1/2 cusp Class II. The interventions applied were a Bionator functional appliance, cervical pull headgear with a removable bite plane or delayed treatment for the control group. Early treatment involved 2 years of active therapy followed by 6 months of retention.

The North Carolina study was a single centre parallel group, randomised, controlled trial with 2 treatment phases. [9–14] The mean participant age was 9.4 years. Patients with an overjet of more than 7mm were randomly assigned to three groups: 1) Bionator treatment 2) combination-pull headgear and 3) a

control group. Phase 1 of the trial lasted 15 months and phase 2 between 25.5 and 34.5 months.

The Manchester study was a multi-centred parallel group, randomised, controlled trial. [15–18] The children in the treatment group were 9.7 years of age and 9.8 years of age in the control group. All patients had an overjet of more than 7mm. The interventions were either with a Twin-Block appliance (phase 1 of 15 months, phase 2 of 14 months) or delayed treatment with a Twin-Block (24 months).

The Cochrane Review reported that the effects of early compared with later treatment revealed no statistically significant differences in the final overjet, ANB, PAR score or self-concept score. A similar result was found when comparing early treatment with headgear compared with later therapy. Similarly, there were no statistically significant differences between the final overjet, ANB or PAR scores. The only identifiable differences between the early and late treatment groups were the overall longer treatment times and the greater number of appointments experienced by the early groups.

Therefore, based on the highest level of available scientific evidence there is no support for the arguments that early treatment followed by a second phase obtains a more favourable occlusal result, a better overall skeletal change or an improvement in the patients overall psychological health. Delaying treatment therefore until it can all be performed at a single, shorter period of time would appear to be the most appropriate and beneficial.

Traumatic dental injury

Functional appliance treatment

The Cochrane Review[4] however, considered that the advantage in providing early compared with later treatment was a reduction in the incidence of incisal trauma. It was determined that 20% of patients who received early functional appliance treatment reported incisal trauma, compared with 29% of patients who reported incisal trauma following later one phase treatment. An odds ratio of 0.59 (95% confidence interval [CI] 0.35 – 0.99) reflects that, in the early treatment functional appliance group, the odds of incisal trauma was 41% less compared with the one phase group.

O'Brien[19] highlighted a simple explanation of an odds ratio: "When you are interpreting an odds ratio (or any ratio for that matter), it is often helpful to look at how much it deviates from 1. So, for example, an odds ratio of 0.75 means that in one group an outcome is 25% less likely. An odds ratio of 1.33 means that, in one group, the outcome is 33% more likely."[20]

The 95% confidence interval is a statistic that has much more relevance in research than the formerly questionable use of p-values. The 95% confidence interval suggests that, if the study was repeated 100 times, the mean value would fall between two values on 95 occasions. This then provides the reader with an appreciation of the relevance of the reported result. As the 95% CI reported was 0.35 to 0.99, it may be deduced that there is a high degree of uncertainty surrounding this data because the confidence interval is wide.

The Cochrane Review also reported the 'numbers needed to treat' (NNT) as 10 with a 95% confidence interval of 6-175. This result should be regarded with a high degree of suspicion because of the extremely large confidence interval. The NNT is an important measure which indicates the number of children who would need to be treated early to prevent one episode of trauma. Therefore, a NNT of 10 indicates that early functional appliance treatment prevents a new incisal trauma in 1 in every 10 patients. The NNT is calculated as 1/Risk difference (for this data 1/0.1).[21]

Headgear treatment

The early headgear treatment group had almost half the incidence of new incisal trauma compared with the one phase group (23% compared to 39%). The odds ratio was 0.47 which indicated that, in the early headgear group, the chance of trauma was 53% less likely than for the group whose treatment was delayed until adolescence. In this case, the 95% CI for the odds ratio was 0.27 to 0.83 which again reflects a high degree of uncertainty surrounding the data and should be interpreted cautiously. The NNT indicates that early headgear treatment prevents one incisal trauma incident for every 6 patients treated.

Apart from dental caries, traumatic dental injuries comprise a highly significant oral problem with an incidence of 1-3%.[22] A meta-analysis reported that the proportion of traumatic dental injuries worldwide attributable to an increased overjet is 21.8% (95% CI 9.7-34.5%).[23] This review reported at least twice the odds of trauma to the permanent teeth if an overjet was greater than 3-4mm. The odds ratio for an overjet of 3-4mm was 2.01 (95% CI 1.39-2.92) and for an overjet of 6+/-1mm was 2.24 (95%CI 1.56-3.21). From an orthodontic perspective, an overjet of 3-4mm is not significantly increased and, despite the best efforts of many clinicians, there are still a number of patients who 'finish' orthodontic treatment with an overjet of this magnitude.

This poses the question of the extent to which orthodontic treatment can truly reduce the chance of traumatic dental injuries if patients with an end of treatment overjet of 3-4mm are still at twice as likely

to experience trauma compared with patients possessing a minimal overjet.

Case study for early treatment

An 8 year old female, PW, presented with a 12mm overjet in the mixed dentition (Figure 1a). She reported previous trauma to both upper central incisors which had composite restorations to manage the enamel-dentine fractures. She was also experiencing significant school bullying related to her teeth. Taking these two factors into consideration, PW opted to embark on a course of early treatment with a Twin Block appliance. Nine months of early twin-block treatment resulted in a reduction of the overjet to 3mm (Figure 1b). PW then transitioned to a bite plane to aid retention of the 3mm overjet (Figure 1c).

Case study for a single course of comprehensive treatment

An 11 year old male, LG, presented with a 14mm overjet in the permanent dentition (Figure 2a). He was treated with a Twin Block appliance for 12 months which reduced the overjet to 3mm (Figure 2b and 2c). As the patient was in the permanent dentition, it enabled a smooth transition to fixed appliances (Figure 2d). Therefore, only one course of comprehensive treatment was provided (Figure 2e).

The cephalometric superimposition (Figure 2f) suggests favourable skeletal changes following functional Twin Block treatment. There has been favourable forward growth/repositioning of the mandible with relatively less maxillary growth. Dentoalveolar changes show the lower molars have mesialised more than one molar tooth width, whilst mesial movement of the upper molars has been restricted. The upper incisor inclination has improved by 3° to 110°, while the lower incisors have proclined by 6° but are still within normal limits.

OTHER CONSIDERATIONS IN THE EARLY CLASS II TREATMENT DEBATE

Costs and burden of care

The cost of treatment for dental injuries has been reported to range from US $2–$5 million per 1 million people with patients usually requiring 2–9 dental appointments to complete restorative treatment.[22] There are, however, a significant proportion of dental injuries that do not require active intervention. In the Cochrane Review, the majority of traumatic injuries were graded as minor and involved enamel only. The

Fig. 1 (a) Patient PW, an 8 year old female with a 12mm overjet in the mixed dentition. (b) 9 months into early Twin Block treatment with an overjet of 3mm. (c) Bite plane to aid retention of the reduction in overjet.

Fig. 2 (a) 11 year old male patient, LG, in the permanent dentition, presented with a 14mm overjet. (b) A Twin Block appliance was fitted. (c) LG following 12 months of Twin Block treatment which reduced the overjet to 3mm. (d) Smooth transition from the Twin Block appliance to fixed appliances. (e) LG, post treatment. (f) Cephalometric superimpositions. Overall superimposition, registered on Sella-Nasion line at Sella. (Black = pre-treatment, Green = post-twin block treatment).

extent that traumatic injuries impact on the costs of treatment and the burden of care for patients is largely unknown. The burden of care for both early orthodontic treatment and the management of dental trauma includes time away from school for the patients and time off work for their parents if they accompany their children to appointments. Treatment can also be very demanding on compliance, as well as the psychosocial implications of wearing appliances. These factors require consideration as they can lead to a degree of distress, particularly if the patient is emotionally immature.

The financial burden for the treatment of incisal trauma should be weighed against the cost of providing two phases of orthodontic therapy purely to reduce the need for this treatment. In countries in which treatment is not provided from a public fund, a full discussion is required between all parties regarding the financial implications of early orthodontic treatment compared with the management of a traumatised incisor.

Mouth guards

None of the trials on early treatment included in the Cochrane Review reported whether mouth guards were used by patients or indeed how the trauma occurred. No account was taken of the extent of patients' involvement with sporting activities. It has been reported that in pre-school aged children, falls are the most common cause of oral injuries whereas in school-aged children, the aetiology of oral trauma is more often sports or non-accidental injuries.[22] Undoubtedly, mouth guard use will reduce dental trauma caused during contact sporting activities; however, it is unknown how the use of mouth guards compares with early orthodontic treatment in reducing the chance of all traumatic dental injuries.

This uncertainty should be discussed with patients and parents, alongside an assessment of the child's engagement in sporting activities. The fact that mouth guards are cheaper and have a significantly reduced burden of care, are positive aspects compared with early orthodontic treatment.

Patient related outcomes

Although self-concept improved initially in patients receiving early treatment,[4] this enhancement was lost by the end of subsequent phase 2 therapy. The unknown however, is whether a transient increase in self-concept following first phase intervention, has any clinical relevance. It would appear to be self-evident that enhancing a child's self-esteem at an early age has to be a positive outcome but scientific evidence is

lacking. The impact on self-esteem and self-concept would be extremely helpful information, particularly in cases in which a child is being teased or bullied at school.

Additionally, traumatic dental injuries have been reported to have a negative impact on the emotional and social domains of the oral health-related quality of life of children.[24] This is a further aspect of the debate which requires consideration. If the extent of the impact on the oral health-related quality of life from dental injuries is considerable, perhaps patients and parents will consider that early orthodontic treatment is worth the financial costs and burden of care.

CONCLUSION

Current best evidence suggests that routine early treatment for Class II division I malocclusions is not effective at improving the final orthodontic outcomes. This does not mean however, that early treatment is never indicated.

There will be a group of patients for whom a malocclusion is so aesthetically distressing, and/or who are being teased so significantly, that treatment is most certainly indicated.

The case may also be argued for those patients who are deemed to have such active lifestyles that their sufficiently large overjet puts them at a higher risk of trauma.

The authors support the sentiment expressed by O'Brien[25] that evidenced base care should always incorporate three very important components: clinical research, clinical experience and patient opinion.

The recommendations for discussions with patients and their guardians are:

- It is possible to have early treatment
- There will be a cost for this treatment both in time and finances
- There will be significantly increased number of appointments associated with early treatment and patients may finish with exactly the same outcome
- When appliances are on longer there is more risk of damage to the teeth
- In certain countries, financial concerns (both for the patient and healthcare system) may influence the decision to pursue treatment
- The enhancement in self-esteem will only be temporary
- It may reduce the incidence of bullying
- The chance of trauma to the front teeth may be reduced
- All other claims as to the benefits of early treatment of prominent front teeth are not based on any scientific evidence.

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