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Early correction of posterior crossbite—a cost-minimization analysis

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SUMMARY There are few cost evaluation studies of orthodontic treatment. The aim of this study was to determine the costs of correcting posterior crossbites with Quad Helix (QH) or expansion plates (EPs) and to relate the costs to the effects. To determine which alternative has the lower cost, a cost-minimization analysis was undertaken, based on that the outcome of the treatment alternatives is identical. The study comprised 40 subjects in the mixed dentition, who had undergone treatment for unilateral posterior crossbite: 20 with QH and 20 with EPs. Duration of treatment, number of appointments, broken appointments, and cancellations were registered. Direct costs (for the premises, staff salaries, material and laboratory costs) and indirect costs (loss of income due to parent's assumed absence from work) were calculated and evaluated for successful treatment alone, for successful and unsuccessful treatment and re-treatment when required.

The QH had significantly lower direct and indirect costs, with fewer failures requiring re-treatment. Even the costs for successful cases only were significantly lower in the QH than in the EP group. The results clearly show that in terms of cost-minimization, QH is the preferred method for correcting posterior crossbite in the mixed dentition.

Introduction

For many years there has been increasing emphasis on economic evaluation of health care interventions (Elixhauser *et al.*, 1993). Delivery of equitable health care in a cost-effective environment requires assessment of the economic implications of different interventions (Kumar *et al.*, 2006). With limited resources in the health sector (personnel, time, facilities, equipment, and expertise); failure to apply the principles of cost-effectiveness may bring an 'opportunity cost', manifested as unsustainable financial overexpenditure, or reduced services in other areas of health care (Drummond *et al.*, 2005; Tickle, 1997). In future, economic evaluations are expected to assume increasing importance in the delivery of publicly funded orthodontic services: When allocating resources, health service planners will require evidence not only of the clinical effectiveness of treatment but also data disclosing 'value for money' (Buck, 2000).

Economic evaluation is defined as 'the comparative analysis of alternative courses of action in terms of their costs and consequences' (Drummond *et al.*, 2005). Depending on the way in which the consequences are analyzed, four types of evaluations can be used to gather evidence and compare the expected costs and consequences of different procedures. A 'cost-effectiveness analysis' is characterized by analysis of both costs and outcomes, where the outcomes of alternative methods might differ in magnitude. In a 'cost-minimization analysis', which is a form of cost-effectiveness analysis, the outcomes of the treatment alternatives are identical (e.g. crossbite will be corrected irrespective of which treatment is applied) and the aim is to identify which alternative has the lower cost. A 'cost-utility analysis' is concerned with the quality of the health outcome following treatment and is used for example, in health-related quality of life studies. In a 'cost-benefit analysis' the consequences are expressed in monetary units. This is used to evaluate distribution of resources to diverse areas of health care (Drummond *et al.*, 2005).

Posterior crossbite is one of the most common malocclusions in the primary and mixed dentitions, with a prevalence of 8.5–17 per cent (Thilander and Myrberg, 1973; Heikinheimo, 1978; Bassler-Zeltmann *et al.*, 1998; Perillo *et al.*, 2010). Early treatment is important to facilitate normal facial growth and development of the jaws (Troelstrup and Moller, 1970; Ingervall and Thilander, 1975; Thilander *et al.*, 2002). A number of studies have shown that treatment by fixed appliances is more effective than treatment by removable appliances (Permert *et al.*, 1998; Bondemark and Karlsson, 2005; Giuntini *et al.*, 2008). Our recent randomized controlled trial (RCT) studies of early crossbite correction with Quad Helix (QH) and expansion plates (EPs) (Petrén and Bondemark, 2008, 2011) found similar clinical outcomes for the two methods.

Systematic reviews of the relevant literature have highlighted the need for studies of the cost-effectiveness of crossbite correction (Harrison and Ashby, 2001; Petrén *et al.*, 2003; Swedish Council of Technology Assessment in Health Care, 2005). Such studies are dependent on the quality of the underlying clinical evidence and should preferably be based on the outcomes of carefully conducted RCTs, with adequate follow-up periods, to confirm the long-term stability of the initial outcomes.

The results of an RCT study using QH or EPs with a 3 year follow-up period (Petrén *et al.*, 2011) indicated that these two treatment approaches, when properly accomplished, achieve similar clinical outcomes; cost-minimization analysis was therefore an appropriate form of economic evaluation. Thus, the aim of the present study was to evaluate and compare the costs of crossbite correction using QH and EPs and to relate the costs to the effects. It was hypothesized that QH and EPs will be equally cost-effective.

Materials and methods

Subjects

This cost-minimization analysis was based on the treatment outcomes of two RCT studies, i.e. on the effectiveness of crossbite correction (Petrén and Bondemark, 2008) and on the 3 year stability of posterior crossbite correction (Petrén *et al.*, 2011). The studies comprised 40 subjects (24 girls and 16 boys) with unilateral posterior crossbites. The sample size had initially been calculated as a minimum of 12 subjects in each group but to increase the power even further and to compensate for conceivable drop-outs during the trial, it was decided to select 15 patients for each group. (Petrén and Bondemark, 2008). Furthermore, when planning the follow-up study, it was decided to add 10 more subjects (five in each group) to increase the power even more and compensate for conceivable drop-outs (Petrén *et al.*, 2011).

All patients had been informed of the purpose of the trial and were required to give written informed consent before being enrolled. Twenty of the crossbite patients had formerly been treated with QH appliances and twenty with EPs. In the EP group, five patients with poor compliance failed to complete the study and one patient in the QH group had relapsed at the 3 year follow-up. Thus, these six patients needed re-treatment, and this was done with QH appliances by the same clinician as before. These six patients needing re-treatment showed no differences in baseline characteristics compared to the successful patients and were evenly distributed between the clinicians in the study. The patient flow is illustrated in Figure 1. All patients were recruited consecutively from two public dental clinics, (Oxie and Trelleborg, Skåne County Council, Sweden) and the Department of General Paediatric Dentistry, Faculty of Odontology, Malmö University, Malmö, Sweden. The patients met the following inclusion criteria: mixed dentition (all incisors and first molars in occlusion), unilateral posterior crossbite, no sucking habits or sucking habit discontinued at least 1 year before trial start, and no previous orthodontic treatment. The patients and their parents were given detailed oral and written information about the trial by five experienced general dental practitioners, who then treated the patients according to a preset standard concept and under the supervision of specialist orthodontists. The Ethics Committee of Lund University, Lund, Sweden, which follows the guidelines of the Declaration of Helsinki, approved the informed consent form and the study protocol, reg. no. LU 399-00.

Quad helix

The QH appliance consisted of a standard stainless steel arch (MIA system; 3M Unitek, Monrovia, California, USA) with stainless steel bands fixed to the maxillary first molars with glassionomer cement (Figure 2). The appliance was

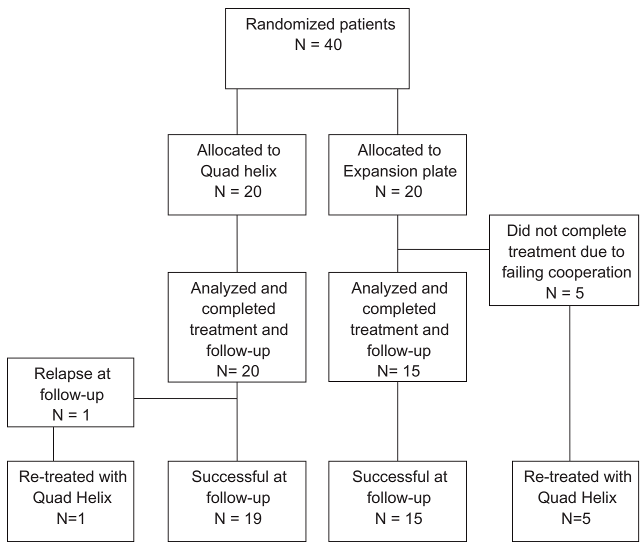

Figure 1 Flow chart of the patients in the study.

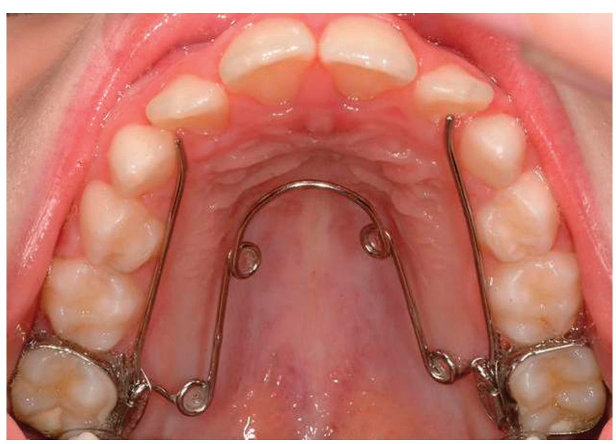

Figure 2 Occlusal view of the Quad Helix appliance.

activated 10 mm before insertion and then, when necessary, reactivated every 6 weeks until normal transverse relationship was achieved. To prevent or compensate for buccal tipping, the appliance was adjusted for buccal root torque. No over-correction was carried out, i.e. no further activation was performed since normal transverse relation was achieved. The treatment result was retained with the current appliance for the following 6 months.

Expansion plate

The EP was made of acrylic with an expansion screw and stainless steel clasps on the first primary and permanent molars (Figure 3). The patient activated the screw 0.2 mm once a week until normal transverse relationship was achieved. The patient was instructed to wear the plate night and day, except for meals and tooth brushing. No over-correction was carried out, i.e. no further activation was performed since normal transverse relation was achieved. The treatment result was retained with the current appliance for the following 6 months.

Effects

The outcome to be assessed was the success rate of crossbite correction (normal transverse relationship) and the degree of maxillary expansion in millimetres, after active treatment and after a follow-up period of 3 years. Maxillary expansion was measured on study models, using a sliding caliper (Mauser, Digital 6, 8M007906, Winterthur, Switzerland). All measurements were blinded (i.e. the examiner was unaware of which treatment the patient had received). One orthodontist (senior author, SP) undertook all measurements.

Costs

'Direct costs' comprised material costs and treatment time costs. Material costs (i.e. impression material, orthodontic bands, orthodontic cement, consumables, laboratory material and fees, etc.) were compiled and calculated according to average commercial prices. Treatment time costs included the costs of the premises, dental equipment, maintenance, and cleaning and were calculated according to average commercial prices in Sweden; these figures were used to establish estimated costs for each unit in the study. Similarly, staff salaries, including payroll tax, were calculated for dental assistants, general dental practitioners, and the supervising orthodontists. The treatment time cost was calculated and estimated in Swedish currency, at SEK 900 or in Euros, at €98 per hour. Treatment time (in minutes) for both scheduled and unscheduled appointments, the number of appointments, broken appointments, and cancellations were registered on an individual basis, on a form included in the patient records.

'Indirect costs' were defined as loss of income (wages plus social security costs) incurred by the patients' parents, assuming that they were absent from work to accompany the patient to the orthodontic appointment. Data sourced

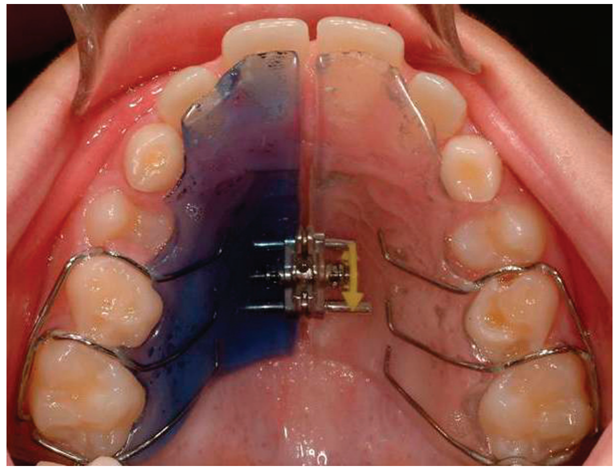

Figure 3 Occlusal view of the expansion plate.

from the Swedish National Bureau of Statistics (www.scb.se) gave the wages of an average Swedish worker as SEK 235 or ~€26 per hour. The parent's absence from work was estimated at 90 minutes per appointment, i.e. 30 minutes for the appointment and 60 minutes travelling time for parent and child from work and school to the dental clinic. All costs were based on 2010 prices and were expressed in Euro (€), SEK 100 = €10.94 on 14 December 2010 (www.xe.com).

The sum of direct and indirect costs was defined as 'societal costs'. The cost-analysis was based on the Intention-To-Treat (ITT) principle, i.e. the analysis included all data on costs for patients needing re-treatment due to non-compliance and relapse.

Cost-minimization analysis

A cost-minimization analysis was undertaken, on the assumption that the consequences of the treatment alternatives are identical (i.e. crossbite will be corrected irrespective of which treatment alternative is applied). Several calculations were made; with higher values (i.e. higher costs) indicating relatively less cost-minimization than lower values (i.e. lower costs).

$$\mathrm{CMa} = \frac{\text{Societal costs}}{\text{Number of patients}}.$$

The first calculation (CMa) divides the societal costs by the number of patients evaluated in each group. This was performed for:

1. the mean costs of successful cases only on completion of active treatment in both groups, i.e.
    - Societal costs for all 20 successful QH treatments divided by the 20 successful QH patients.
    - Societal costs for all 15 successful EP treatments divided by the 15 successful EP patients.

2. The actual mean costs of the successful cases on completion of active treatment in both groups, i.e.
   - Societal costs for all 20 QH treatments divided by the 20 successful patients.
   - Societal costs for all 20 EP treatments divided by the 15 successful patients.

$$\text{CMb} = \frac{\text{Societal costs including re-treatment}}{\text{Number of patients}}.$$

The second calculation (CMb) divides the societal costs for all patients, including the 3 year follow-up period and all re-treatment, with the total number of patients in each group. Thus, the costs of one re-treatment in the QH group and five re-treatments in the EP group were added to the societal costs to calculate the 'mean societal costs including re-treatments.' This implies:

- Societal costs for 21 treatments in the QH group divided by 20 patients.
- Societal costs for 25 treatments in the EP group divided by 20 patients.

Statistical analysis

The data were statistically analyzed using the Statistical Package for the Social Sciences (SPSS, version PASW 18, Chicago, Illinois, USA). The arithmetic mean and standard deviation (SD) were calculated. Differences in costs between the two groups were analyzed by Student's t-test. A P value < 0.05 was considered as statistically significant.

Results

Societal costs

The mean societal costs for the patients with successful treatment outcomes (20 QH and 15 EP) were €981 (SD 150) for the QH patients and €1124 (SD 191) for the EP patients ($P < 0.05$).

To achieve 15 successful treatment outcomes with EPs, 20 patients had to undergo treatment. Thus, the mean societal costs, including both successful and unsuccessful outcomes, (20 QH and 20 EP) were €981 (SD 150) for the QH group and €1533 (SD 191) for the EP group ($P < 0.001$).

As five of the EP treatments failed during active treatment and one of the QH treatments relapsed during the 3 year follow-up period, these patients had to undergo further treatment (with QH) to achieve crossbite correction. Thus, the final mean societal costs for successful treatment outcome for all 20 patients in each group were €1031 (SD 244) for the QH group and €1395 (SD 539) for the EP group, i.e. EP treatment was 35 per cent more expensive than QH ($P < 0.01$). The costs are summarized in Table 1. Figure 4 shows a decision tree using TreeAge soft ware (TreeAge

Table 1 Mean societal costs (Euro) for the Quad Helix group (A) and the expansion plate (EP) group (B) for successful patients only, successful and unsuccessful patients, and after re-treating one patient in the Quad Helix group and five in the EP group.

	Quad Helix		Expansion plate		95% Confidence interval for difference		Difference between groups
	Mean	SD	Mean	SD	Lower	Upper	
Successful patients only	$n = 20$		$n = 15$				
Mean total costs	981	150	1124	191	26	260	EP > QH*
Successful and unsuccessful	$n = 20$		$n = 15$				
Mean total costs	981	150	1533	191	435	669	EP > QH***
Including re-treatment	$n = 20$		$n = 20$				
Mean total costs	1031	244	1395	539	94	636	EP > QH**

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$; NS, not significant.

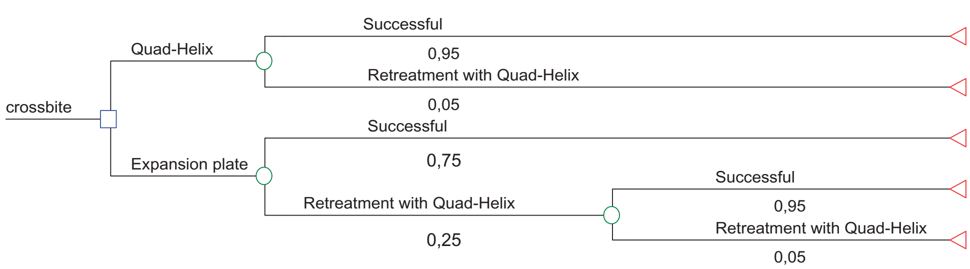

Figure 4 Decision tree (TreeAge Software) showing a model of the paths that appeared based on the data of this study. As 0.05 (1/20) of the Quad Helix treatments had to undergo re-treatment, these facts were also theoretically assumed for the re-treatments.

Software, Inc., Williamstown, Massachusetts, USA, www.treeage.com) that structurally illustrates and compares the treatment alternatives.

Direct costs—material

The mean material costs for the patients with successful treatment outcomes (20 QH and 15 EP) were €230 for QH and €285 for EP. The mean material costs for both successful and unsuccessful outcomes (20 QH and 20 EP) were €230 for QH and €380 for EP. When re-treatment is included, the mean material costs for the QH group were €241 and €343 for the EP group.

Direct costs—treatment time

The mean total treatment time for the patients with successful treatment outcomes (20 QH and 15 EP) was 219 minutes in each group and the mean cost for treatment time was €359. The mean total treatment time and costs, for both successful and unsuccessful outcomes, (20 QH and 20 EP) were 219 minutes/€359 for the QH and 299 minutes/€491for the EP group. Including the re-treatments, the mean total treatment time and costs for the QH group were 230 minutes/€377 and 279 minutes/€458 for the EP group. The distribution of the different costs is summarized in Table 2.

The mean number of appointments for patients with successful treatment outcomes was 10.2 for the QH patients and 12.4 for the EP patients. The mean number of appointments for both successful and unsuccessful outcomes (20 QH and 20 EP) was 10.2 for the QH and 17.1 for the EP group. Including re-treatment, the mean number of appointments was 10.7 and 15.4, respectively.

In each treatment group, there was an average of one acute/unscheduled appointment per treatment, most frequently for loss of ligatures or molar bands or displacement of the palatal arch in the QH group and in the EP group and for repair or replacement of an appliance due to fracture or unsatisfactory fit.

Table 2 Mean costs (Euro) showing the distribution of direct costs (material and time costs) and indirect costs for successful patients only, successful and unsuccessful patients, and after re-treating one patient in the Quad Helix group and five in the expansion plate group.

	Successful only	Successful and unsuccessful	Including re-treatment
Quad Helix			
Societal costs	981	981	1031
Direct costs —material	230	230	241
Direct costs —time	359	359	377
Indirect costs	392	392	413
Expansion plate			
Societal costs	1123	1533	1395
Direct costs —material	285	380	343
Direct costs —time	359	491	458
Indirect costs	479	662	594

Indirect costs

Indirect costs were €39 per appointment. Multiplied by the number of appointments, the mean indirect costs for successful treatments were €392 for the QH group (20 successful treatments) and €479 for the EP group (15 successful treatments.) The mean total indirect costs, including both successful and unsuccessful outcomes (20 QH and 20 EP), were €392 for the QH group and €662 for the EP group. However, including the re-treatment appointments, the indirect costs for the QH group were €413 and €594 for the EP group. Thus, the mean indirect costs for the EP group were 43.8 per cent higher than for the QH group.

Maxillary transverse changes

The maxillary transverse changes during active treatment, post-treatment, and during the total observational period are summarized in Table 3.

Discussion

There are few published studies of economic evaluations of orthodontic treatment. This is the first study to evaluate cost-minimization of crossbite correction by the QH or maxillary EP methods, based on outcomes of an RCT study, with indirect costs included. The results reject the initial hypothesis that QH and EPs will be equally cost-effective and show that the QH method is the more cost-effective alternative.

A prospective RCT has several advantages as a basis for health economic evaluation. The randomization process diminishes the risk of error due to factors such as selection bias, the clinician's preferred treatment method, and the individual differences in the skills of the general dental practitioners with respect to the various treatment methods as well as the skills of the dental technicians. Furthermore, random allocation of subjects reduces bias and confounding variables by ensuring that both known and unknown determinants of outcome are evenly distributed among the subjects. The prospective design also ensures that the baseline characteristics, treatment progression, treatment time, number of appointments, and side effects can be strictly controlled and accurately observed. However, in studies of limited sample size, the clinicians' skills or lack of experience might still be a confounding factor. Initially the minimal sample size for the RCT study had been calculated as 12 subjects in each group (Petrén and Bondemark, 2008), but in order to increase the power and to compensate for possible attrition, 10 more subjects were included in the follow-up study (Petrén *et al.*, 2011). The treatments in the present study were performed by experienced general

Table 3 The difference in maxillary intermolar distance and intercuspid distance (in millimetres) during treatment (T1 − T0), post-treatment (T2 − T1), and the total observational period (T2 − T0).

	Quad Helix *n* = 20		95% Confidence interval for mean		Expansion plate *n* = 15		95% Confidence interval for mean		
	Mean	SD	Lower	Upper	Mean	SD	Lower	Upper	Group difference
Difference records T1 − T0									
Intermolar distance, gingival margin	3.7***	1.58	2.9	4.4	3.2***	1.24	2.5	3.9	NS
Intermolar distance, mesiobuccal cusp tips	4.1***	1.45	3.5	4.8	3.8***	1.62	2.9	4.7	NS
Intercanine distance, gingival margin	1.5**	1.64	0.7	2.3	2.4***	1.44	1.5	3.3	NS
Intercanine distance, buccal cusp tips	2.7***	1.57	1.9	3.4	2.6***	1.58	1.7	3.6	NS
Difference records T2 − T1									
Intermolar distance, gingival margin	−0.8*	1.48	−1.5	−0.2	−0.6	1.14	−1.2	0	NS
Intermolar distance, mesiobuccal cusp tips	−0.8	1.7	−1.5	0	−0.4	1.33	−1.1	0.4	NS
Intercanine distance, gingival margin	−1.2***	1.19	−1.8	−0.6	−1.4*	1.54	−2.4	−0.3	NS
Intercanine distance, buccal cusp tips	0.4	1.67	−0.4	1.3	0.2	1.09	−0.5	0.9	NS
Difference records T2 − T0									
Intermolar distance, gingival margin	2.8***	1.71	2	3.6	2.6***	1.19	1.9	3.3	NS
Intermolar distance, mesiobuccal cusp tips	3.4***	1.38	2.7	4	3.5***	1.19	2.8	4.1	NS
Intercanine distance, gingival margin	0.2	1.88	−0.7	1.1	0.6	2.25	−0.8	2.1	NS
Intercanine distance, cusp tips	3.2***	2.28	2.1	4.3	2.5***	1.68	1.5	3.5	NS

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$; NS, not significant analysis of variance.

clinicians and the laboratory work was performed by experienced dental technicians.

In general terms, the main findings of this study are in accordance with those of some previous studies. A retrospective study by Hermanson *et al.* (1985) reported that treatment with EPs was 40 per cent more expensive than treatment with QH. The calculations were based on material and chair-time costs of successful cases only, and indirect costs were not included. In another retrospective study (Ranta, 1988), the average laboratory costs for the EP group were three times greater and the number of appointments was 3.5 times greater than in the QH group. A study by Bjerklin (2000) reported a few more cases of relapse in the QH group (3/19) than in the EP group (1/19). Despite variations in study design and the lack of separate cost-minimization analyses including direct and indirect costs in these earlier studies, there is general agreement with the findings of the present study that treatment with QH offers greater economic benefits than treatment with an EP. In a recently published analysis on cost-effectiveness (Pietilä, 2010), general practitioners/early treatment versus specialists in orthodontics/late treatment was analyzed at eight health centres in Finland. The study showed a wide variety of costs and treatment approaches and concluded that the cost-effectiveness seemed to be equal for early and late treatment.

Evaluation of treatment effects and costs should be based on the ITT approach, meaning that all cases, successful or not, are included in the analysis. In this study, EP treatment was clearly more expensive, partly because five of the patients had to be re-treated due to poor compliance compared with only one re-treatment in the QH group, due to relapse. However, even when analysing only the successful cases, the costs in the EP group were significantly higher.

The societal costs for the EP group differed significantly over time. For immediate successful outcomes, the mean costs were €1124 for the EP group, but for both successful and unsuccessful outcomes, the mean costs increased to €1533. However, when calculating the costs of achieving a successful outcome for all EP patients, i.e. including re-treatment costs for six of the patients, the mean costs decreased to €1395. Thus, although re-treatment incurred additional costs, the mean costs decreased as the number of successful patients increased.

Numerous factors may contribute to the differences in the costs between the two treatment groups. By far the major direct cost is treatment time, particularly staff salaries; the salaries of the dentists and dental assistants accounted for about 85 per cent of total treatment time costs. The mean total treatment time and the number of appointments were significantly greater for the EP group, possibly attributable to poor patient compliance. The greater number of appointments is also reflected in higher indirect costs in the EP group. These data support the principle of preferring treatment methods that are less dependent on patient compliance, in order to ensure that treatment time and number of appointments are as low and effective as possible. Moreover, there is evidence from several studies that fixed appliances are more effective than removable appliances (Permert *et al.*, 1998; Bondemark and Karlsson, 2005; Giuntini *et al.*, 2008).

The relatively high number of patient appointments in this study may be attributable to the fact that treatment was provided by general dental practitioners, whereas treatment in a specialist orthodontic clinic would be less time-consuming, reducing both direct and indirect costs. However, increased costs incurred for specialist salaries and possibly increased travel time for patients and parents would need to be factored in.

An inherent difficulty in economic evaluation is ascertaining the true values for all the key aspects of an intervention: when values need to be estimated, some uncertainty arises about the true cost-effectiveness (Gold *et al.*, 1996). It was necessary to estimate the mean parental time per visit and a period of 90 minutes was selected as reasonable for the time required, not only for the appointment but also travelling time from workplace and school for parent and child. When planning/designing the study, a protocol for the parents could have been used to achieve more exact and individual data regarding the parents' absence from work etc.

It may be argued that the close supervision of patients in a trial yields encouraging outcomes which may not reflect everyday clinical conditions and that the data should therefore not be extrapolated to the general population. However, the patients participating in the present RCT were treated primarily by general dental practitioners in their local dental clinics under the supervision of a consultant orthodontist, simulating conventional conditions for treatment of posterior crossbite in the Swedish dental services. The outcomes should therefore reflect those to be expected in the general population.

The clinical studies which the present study is based on (Petrén and Bondemark, 2008; Petrén *et al.*, 2011) showed that over-correction is not necessary, i.e. only one relapse of 35 successful treatments occurred although no over-correction was carried out.

Regarding the results of this study, it is correct to state that EP should not be used accustomably. However, due to the design of the appliance, the EP can offer supplemented treatment possibilities to crossbite correction in some specific cases if the clinician is certain that the patient will co-operate. For example, spring coils or labial arches can easily be inserted to an EP when the aim besides to crossbite correction is to simultaneously correct the position of the incisors. Furthermore, the treatment decisions should always be performed on an individual basis and not only from economical aspects.

While the mean cost differences in the present study are clearly significant, extrapolation of the data to a national level further highlights the differences between the economics of the two treatment modalities. In 2009, there were 96 706 eight year old children in Sweden. The prevalence of posterior crossbite is estimated at 10 per cent. Assuming that all cases of posterior crossbite would be treated, the differences in societal costs between the two treatment methods would amount to 3.5 million Euros.

The aim of the present study was to strictly evaluate the cost-effectiveness of posterior crossbite treatment. However, patients' conceptions, both positive and negative, are also important subjects. These aspects are planned to be evaluated in a forthcoming study.

Conclusions

The cost-minimization analysis clearly showed that for correction of posterior crossbite, QH offers significant economic benefits over EP treatment. The QH had lower direct and indirect costs and fewer failures needing re-treatment. Even with full co-operation, i.e. when only successful treatments were considered, EP treatment was more expensive than the QH treatment.

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