



# Alveolar bone grafting: achieving the organisational standards determined by CSAG, a baseline audit at the Birmingham Children's Hospital

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## ABSTRACT

**INTRODUCTION** Birmingham Children's Hospital (BCH) is the centre for a regional comprehensive cleft service attempting to implement the national guidelines for minimum standards of care. A national audit of cleft management (CSAG) found that 58% of alveolar bone grafts were successful; published series suggest that success rates can be of the order of 95%. We present the results of an audit of alveolar bone grafting over a 33-month period, after implementation.

**PATIENTS AND METHODS** A retrospective clinical process audit was taken from the hospital notes and an analysis of radiological outcome by Bergland score was obtained by two independent assessors.

**RESULTS** The audit highlighted the difficulties of integrating the increased clinical workload. Other difficulties included poorly standardised pre- and postoperative occlusal radiography, inconsistent orthodontic management and a lack of prospective data collection. An 81% success rate for alveolar bone grafting compares favourably to the CSAG study. Of 82 patients, 68 had sufficient data for a retrospective review; 21 were our own patients and 47 were referred into the centralised service. The success of bone grafting as defined by CSAG (including Bergland scores) is based on only two-thirds of the patients as many have their orthodontic treatment managed in more distant units and radiographs are much harder to obtain. Bone grafting later than age 11 years, was true for 28% (6/21) of our BCH patients and 46% (22/47) for those referred to our service.

**CONCLUSIONS** This audit demonstrates what has been achieved in a re-organised service in the context of Real Politik in the NHS and suggests the areas that require improvement.

## KEYWORDS

Alveolar bone graft – CSAG – Bergland score

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The NHS is in constant change; the implementation of change is fraught with difficulty and the risk of short-term failure. Cleft services for the UK are no exception to this principle, and have undergone rigorous restructuring since the publication of the findings from Clinical Standards Advisory Group (CSAG) for cleft lip and palate in 1998.<sup>1</sup> As a result of this, the West Midlands regional cleft service has become centralised to the Birmingham Children's Hospital (BCH). Our experience illustrates the practical difficulties that re-organisation has had on our specialty. However, the quality of service has improved subsequent to this implementation. This report provides data for national comparison.

We report a retrospective clinical process audit taken from the hospital notes and a radiological assessment of one outcome measure for this service – the alveolar bone

graft (ABG) success rate. We compare our results to the CSAG study findings prior to local implementation of its recommendations. We discuss the organisational shortfalls revealed by our audit and make proposals for local restructuring of the service based on our findings.

We have chosen to measure alveolar bone grafting as our clinical outcome because of the availability of validation by Bergland scores<sup>2</sup> and because this parallels the main outcome measure used by CSAG for comparison. Bergland established a four-point assessment score of the inter-alveolar height after bone grafting. CSAG recognised types I and II as success and types III and IV as failure.

The CSAG study identified 647 children under the care of 50 different cleft teams. Not all of these children had required alveolar bone grafting and 183 radiographs were

Male:female ratio	2:1
Primary BCH cohort:post-CSAG referred cohort	21:47 patients
Age of children in the post-CSAG referred cohort (years)	Mean, 9.5; median, 9.19; range 6.6–15.3
Number referred after 11 years of age	7 patients
Age at operation (years)	Mean 11.0; median 10.4; range 8.6–16.1

available for analysis. Of this figure, 26 radiographs were found to be unreadable leaving 157. The results revealed that only 58% of bone grafts were successful in this group; which was alarming when compared to a large data set from Oslo giving a success rate of 96%.<sup>2</sup> In response to this figure and other findings in the report, several recommendations were made. It was recommended that expertise and resources were concentrated to 8–15 units from the current number of 57 practising units. It was also recommended that there should be a common database for all cleft lip and palate patients, made available for comparative results. The number of consultant orthodontists dealing with cleft patients was recommended to be reduced; however, it was acknowledged that, for ease of patient access, the availability of district orthodontic practice was valuable. The report suggested the development of a ‘hub and spoke’ arrangement, with the core team at the hub speciality unit responsible for overall management and data keeping. The ‘spoke’ orthodontists would receive regular feedback and education from the ‘hub’. The authors of CSAG acknowledged that this would require some re-organisation of the existing system.

The BCH cleft unit receives 100–120 new cases per year. It is composed of two full-time cleft surgeons, one orthognathic surgeon, 1 part-time orthodontist on site and 14 regional orthodontists. Our findings show that, with centralisation, we have significantly improved upon the CSAG findings; however, we have some way to go before we can achieve the organisational standards it recommends.

**Patients and Methods**

The audit studied the outcomes of alveolar bone grafting from a single operating surgeon at the Birmingham Children’s Hospital between January 2000 and October 2002. Patients were identified from the hospital database. First, a retrospective clinical process audit was taken from the hospital notes. Data were gathered by a team of clinicians to study the general descriptive statistics shown in Table 1 applicable to all alveolar bone grafted patients. Second, two independent assessors performed a validated radiological outcome assessment on all available standard occlusal view radiographs of unilateral ABG. A Bergland

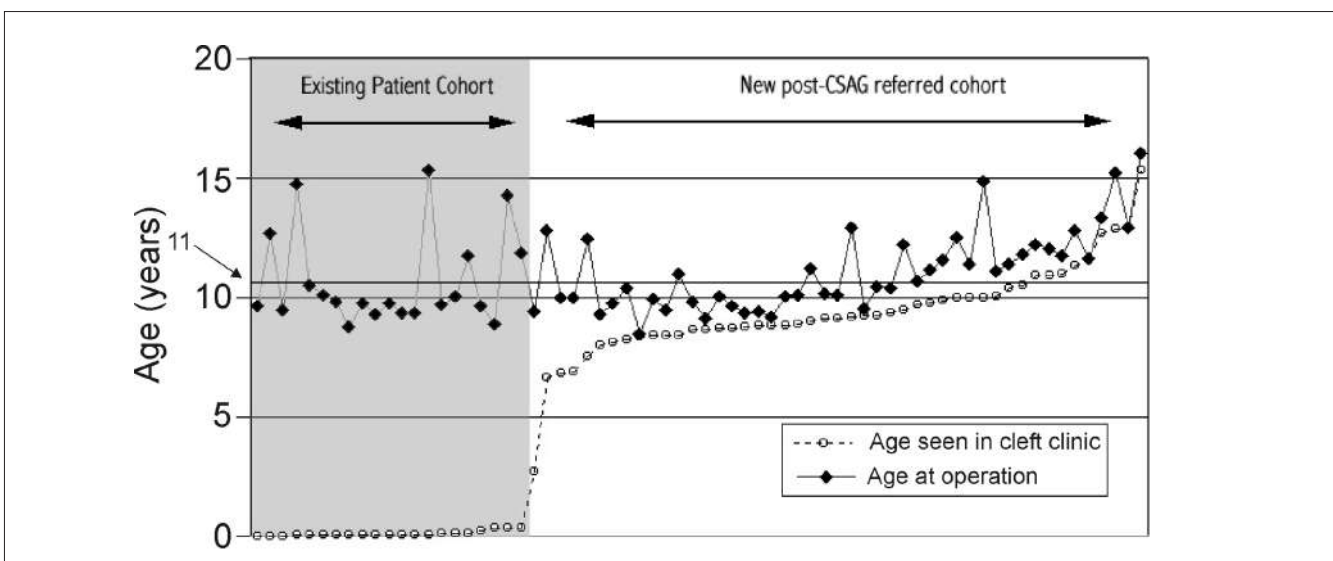


Figure 1. Age first seen in the Birmingham Children’s Hospital clinic versus the age at which alveolar bone grafting was performed.

score was derived according to Bergland's description in 1986. Where there was disagreement, a case discussion was conducted and agreement reached. If the quality of the radiograph or the view was insufficient to make a score, then no score was recorded. As with the CSAG report, we counted grades I and II as successful and III and IV as failure. The results were validated by measuring the inter-observer correlation by Kappa analysis.

Results were collected in a Microsoft Excel database and graphical representation was achieved with this software.

## Results

A cohort of 82 patients was identified from the hospital database from which 68 case notes were available for review. In this group, 47 patients had received their primary surgery elsewhere and had been referred for alveolar bone grafting subsequent to service centralisation following the CSAG report. Twenty-one patients had been under our care from birth including their primary cleft repairs. Of all patients, 19% had received bilateral ABG and 81% were unilateral. All bone grafting was performed by the senior author (MW). Figure 1 shows the age of referral to the cleft service and the corresponding age that the child was given ABG. We use age in this context for ease of comparison with Bergland's definitions;<sup>2</sup> in the clinical setting, age is used only to enter the child into the assessment process by a maxillofacial surgeon and an orthodontist working together in the central clinic. Of the 47 patients that were referred from other units, 26 were referred after the age of 9 years. We achieved ABG by 11 years in 40 out of 68 cases, the majority of delayed ABG being from the referred cohort (Fig. 2). The mean age of ABG was 11 years, 95.5% were grafted before their 12th birthday.

In the BCH primary cohort, we had 6 late bone grafts. From the notes, reasons for this were that 3 patients were poor attendees and 1 case was delayed due to inadequate co-ordination between regional orthodontist and the centre. In 2 cases, there was no recorded reason in the notes. In the referred post-CSAG cohort, of those who could have been operated in the 9–11 years age window, 5 were operated on late due to similar reasons of poor attendance or lack of co-ordination.

## Outcome assessment

Of the 82 patients, 46 unilateral cases had the minimum of 6 months postoperative follow-up allowing a Bergland score. Of these, 8 radiographs were missing and 8 radiographs were taken in the community and were unavailable to the audit. Thirty radiographs were available for scoring. On assessment by two independent assessors, three were found to be unreadable, leaving 27 radiographs to be scored. It was noted that there were variable numbers and timings of occlusal and cephalometric radiographs taken.

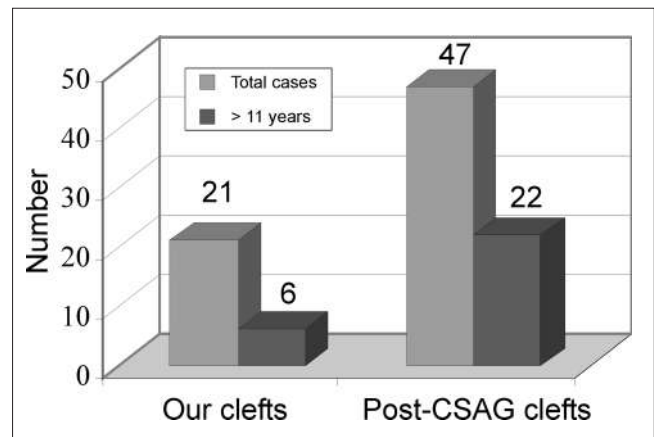


Figure 2. A comparison of the number of children who received late ABG (at more than 11 years) both in those who had been with BCH since birth and those who were later centralised to BCH after the implementation of the CSAG report.

Our results revealed that of 27 radiographs scored, 81% (22 cases) were successful with > 75% bone height (Bergland grades I and II), and 19% (5 cases) were deficient or failed (Bergland grades III and IV). Kappa analysis of inter-observer agreement for successful versus failed grafting was 0.76.

## Discussion

Based upon outcome, we are satisfied that the 81% success rate is an improvement on the CSAG finding of 58%. We are also grafting the patients sooner than the CSAG study, with only 4.5% not grafted by 12 years compared to 15% in the CSAG group.

Whilst our radiological results are satisfactory, we have discovered weaknesses in our system of management. This audit highlighted the difficulties in implementing the CSAG recommendations. In particular, integrating the new patients and operating on them within the optimum period of 9–11 years was difficult; however, we do not anticipate this to be a problem in the future as now all regional cases are our primary responsibility.

This highlights the danger of change; while in the long-term the system will work better, there is a short-term fall out. This is demonstrated by the referred cohort being both referred and then subsequently operated on late; in 7 cases, the child was already older than 11 years on referral. Bergland recommends that ABG is done in the age window of 9–11 years.<sup>2</sup> Although none of the small number of late cases in our study was found to have an unsatisfactory outcome, it has been shown that grafts undertaken later than 11 years have a worse prognosis.<sup>5</sup>

This retrospective clinical audit also demonstrates the lack of a proper prospective audit as recommended by CSAG.

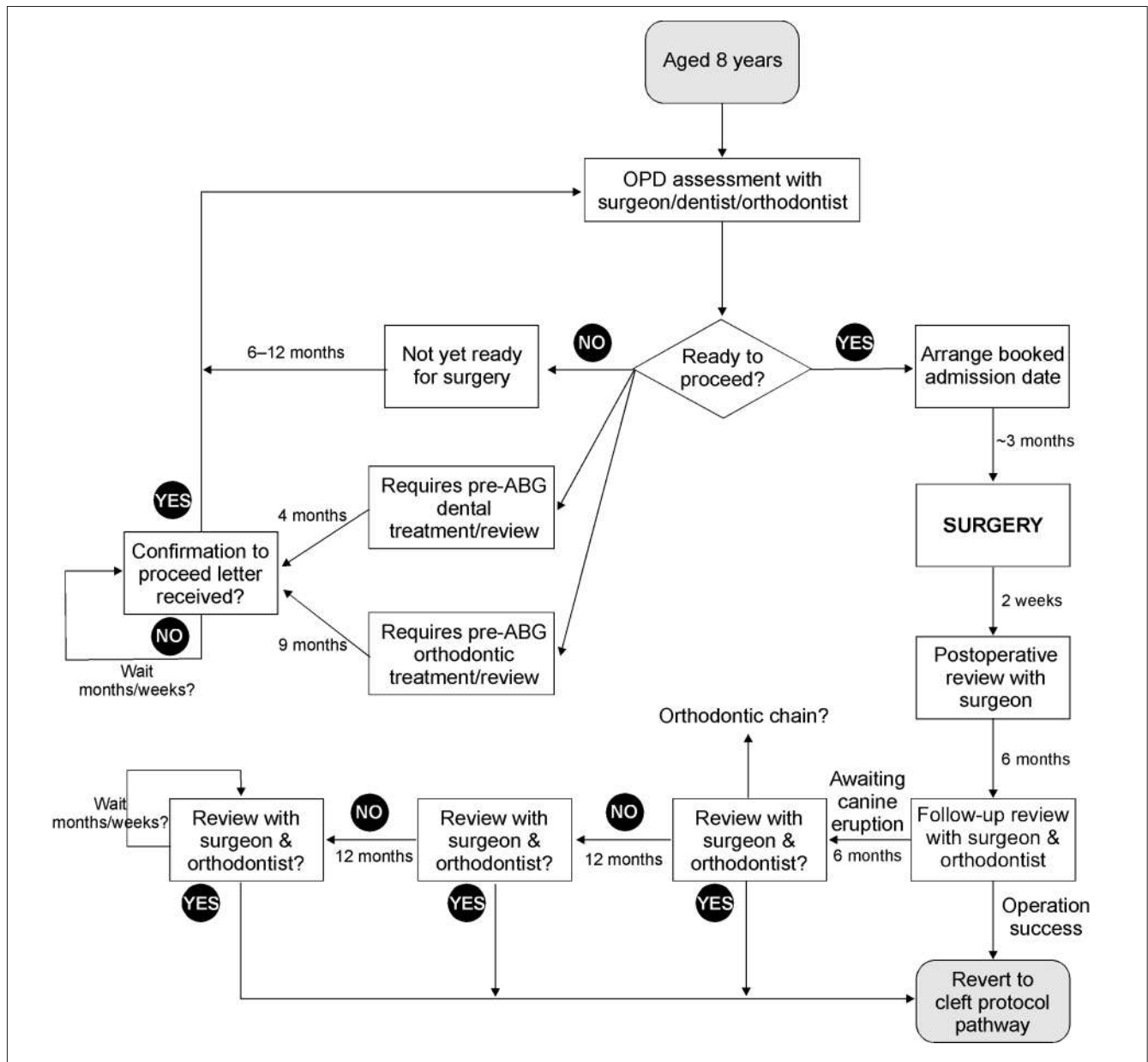


Figure 3. Proposed clinical care pathway for alveolar bone grafting at the Birmingham Children's Hospital.

Overall we were disappointed with the low number of X-rays that were available for scoring (59%), many of which had not been done in the hospital at all but in outlying district orthodontic practices. It highlighted a lack of centralised management.

We felt that the overall number of X-rays being taken of the patients was often inconsistent and tended to be high (up to 9 X-rays in a 4-year period).

This audit, just 20 months into the new CSAG programme, revealed organisational weaknesses that require attention. From it, we recommend that there be stricter out-

patient protocols, a standardisation of radiological assessment, more centralisation of the service and proper prospective data collection. To achieve this, the team has designed an ABG protocol, in conjunction with our regional orthodontic colleagues, which has been incorporated into a clinical care pathway and treatment timings will be co-ordinated by computer database (Fig. 3). We will be using computer-generated reminders to make sure that patients are being assessed at the right stages. Although there are many factors affecting delayed ABG, one remedial problem is the potential for patients to be 'lost' between the hub and spoke.

**Table 2** Standardised protocol for the collection of X-rays, photographs and orthodontic models related to alveolar bone grafting

Timing	Upper occlusal centred over cleft at ~65°	DPT	Peri-apical (parallel)	Photographs	Study models
8-year assessment	✓	✓			
Start of orthodontic treatment (if > 6 months since 8-year assessment)	✓		✓	✓	✓
Just before graft (if > 3 months since assessment or after orthodontics)	✓			✓	
6 months after graft	✓		✓		
After canine fully erupted	✓		✓	✓	✓

DPT, dentopanorthogram; peri-apical (parallel), a peri-apical X-ray using paralleling.

When a patient is referred for pre-ABG orthodontics, the system will remind us if we have not heard back from the orthodontist acknowledging commencement of treatment. Nine months later, a second reminder will be generated to check progress with the orthodontic treatment and determine if the patient is ready for ABG and re-integration with the central hub. This will also apply to pre-ABG dental care.

We have also addressed the radiological assessment with guidelines dictating both the views and timings of X-rays at one site (Table 2).

The drive for these changes is to increase the quality and consistency of the service by greater centralisation while recognising the important role of the district orthodontic practices. CSAG advises that this relationship should be in a 'hub and spoke' (managed clinical network) arrangement.

We are actively negotiating a centralised 'hub' orthodontic management plan, in collaboration with the many 'spoke' orthodontic practices.

From this system, we will also be able to derive a proper centralised prospective audit of the service.

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