Original Article

Orthodontic treatment protocols in patients with alveolar clefting: a survey of ACPA–approved cleft teams in the United States

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ABSTRACT

Objectives: To describe pre– and post–alveolar bone graft (ABG) practice protocols of orthodontists associated with American Cleft Palate-Craniofacial Association–approved cleft and cleft/craniofacial teams.

Materials and Methods: Electronic survey responses from team orthodontists were evaluated regarding pre-ABG orthodontic treatment type(s), timing of post-ABG imaging and post-ABG orthodontic treatment, and craniofacial orthodontic fellowship training status of the team orthodontists. A P value of $<.05$ was considered significant.

Results: Of 31 responding orthodontists, 54.8% had fellowship training and 45.2% did not. Pre-ABG orthodontic preparation ranged from solely maxillary expansion for alveolar segment alignment (35.5%) to a combination of maxillary expansion for both alveolar segment alignment and posterior crossbite correction, anterior tooth alignment, and anterior crossbite correction (19.4%). Most captured post-ABG radiographs prior to orthodontic tooth movement (90.3%). Orthodontists began treatment at least 6 months (35.5%), 2–4 months (32.3%), or 4–6 months (29%) post-ABG. No significant differences were found when comparing fellowship subgroups. In addition, 47.1% of fellowship-trained orthodontists deferred post-ABG orthodontic treatment to at least 6 months post-operatively, vs 21.4% of non–fellowship trained orthodontists ($P = .14$).

Conclusions: A large variation in approaches is evident in pre-ABG orthodontic treatment types and timing of post-ABG treatment. Post-operative imaging is pursued by most orthodontists to assess graft status prior to initiating orthodontic treatment. Additional clinical research is needed to support providers in their decision-making with regard to evidence-based approaches. (*Angle Orthod.* 2022;93:88–94.)

KEY WORDS: Cleft; Alveolar bone graft; Cleft palate; Alveolar cleft; Orthodontic treatment

INTRODUCTION

Comprehensive and collaborative multidisciplinary care from birth to adulthood is recommended for patients with orofacial clefting. The American Cleft Palate-Craniofacial Association (ACPA) specifies that an orthodontist must be a core member of all ACPA-approved teams, highlighting the important role of orthodontic treatment in the care of these patients.[1]

For patients with cleft lip with or without cleft palate, presence of an alveolar cleft most commonly requires an alveolar bone graft (ABG) to unite the maxillary bony segments and provide support for eruption, orthodontic movement of permanent teeth adjacent to the cleft, and, if necessary, tooth replacement. Common orthodontic interventions for these patients are early infant orthopedics, limited orthodontic treatment in childhood to prepare for ABG, growth modification, and comprehensive treatment in adolescence and/or in

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conjunction with orthognathic jaw surgery at skeletal maturity.[2]

Among debated topics in management of alveolar clefting is the orthodontic preparation for ABG and the timing of orthodontic intervention following ABG. While the literature largely supports ABG before eruption of the cleft-adjacent permanent canine (or lateral incisor, if present), some teams favor earlier grafting in the late-primary or early-mixed dentition and suggest improved outcomes.[3,4] Treatment philosophies vary in the orthodontic community, with some advocating for earlier tooth movement post-ABG to stimulate the graft functionally,[5,6] while others elect for longer graft-maturation periods.[7–9]

The degree of clinical exposure to cleft and craniofacial conditions differs among residency programs. Craniofacial orthodontic fellowships offer orthodontists additional training in the management of these conditions following residency. To date, the literature has not investigated orthodontic practice differences between craniofacial fellowship–trained orthodontists and those without this additional training.

Describing treatment approaches of orthodontists affiliated with ACPA-approved cleft/craniofacial teams is important to better understand treatment types and identify additional research needed to support evidence-based treatment. The purpose of this study was to describe pre- and post-ABG orthodontic treatment approaches of orthodontists practicing with ACPA-approved cleft palate and cleft palate/craniofacial teams in the United States. Additionally, when possible, the impact of craniofacial orthodontic fellowship training was assessed.

MATERIALS AND METHODS

An electronic survey was sent to all 162 ACPA-approved cleft palate and cleft palate/craniofacial teams in the United States.[10] REDCap® (Research Electronic Data Capture),[11,12] hosted by the University of California at Los Angeles (UCLA) Clinical and Translational Science Institute, was used for survey distribution and response collection between December 2020 and March 2021. Unique links ensured that each team could only complete one survey. In this study, the following components were evaluated: pre-ABG orthodontic treatment type, timing of post-ABG imaging relative to post-ABG orthodontic treatment, timing of post-ABG orthodontic treatment, and craniofacial orthodontic fellowship status of responding orthodontists. Multiple answers were permitted for the question about treatment type. Given the technical nature of the questions, only surveys completed by team orthodontists were included in this study. The UCLA Institutional Review Board indicated that review was not required as a result of the study design.

Descriptive statistics were calculated for all survey items. Fellowship training groups were compared using Chi-square and Fisher's exact tests, as appropriate. The Cochran-Armitage test for trend was used to examine the association between fellowship training and preferred timing of post-graft orthodontic treatment. Statistical significance was pre-set at $P < .05$, and all analyses were performed using SAS v. 9.4 (SAS Institute Inc, Cary, NC). For multiple response questions, selected responses were assessed in combinations in addition to tabulating individual responses.

RESULTS

An overall survey response rate of 40.7% was achieved, with 66 teams responding. Of those, 31 respondents were orthodontists whose responses were analyzed in this study. Seventeen orthodontists had craniofacial orthodontic fellowship training (54.8%) and 14 did not (45.2%).

Pre-ABG Orthodontic Treatment

Response combinations and total response counts were evaluated for pre-graft orthodontic treatment. The treatments reported were as follows: maxillary expansion to align alveolar segments alone (35.5%), a combination of maxillary expansion for alveolar segment alignment and posterior crossbite correction (19.4%), and a combination of expansion for segment alignment, expansion for posterior crossbite correction, maxillary anterior tooth alignment with fixed appliances, and anterior crossbite correction with fixed appliances and/or facemask (19.4%). All other treatment combinations were less frequent. When grouped, 87.1% of responding orthodontists perform at least maxillary expansion to align alveolar segments, with fewer reporting at least maxillary expansion for posterior crossbite correction (58.1%), maxillary anterior tooth alignment (25.8%), or anterior crossbite correction (22.6%) (Table 1).

Post-ABG Orthodontic Treatment

Nearly all orthodontists (90.3%) reported performing orthodontic tooth movement in the graft area after acquiring imaging of the graft; 9.7% indicated they do so before acquiring imaging (Table 2).

Initiation or resumption of post-ABG orthodontic tooth movement near the graft occurred at least 6 months post-operatively in 35.5% of teams, between 2 and 4 months post-operatively in 32.3%, and between 4 and 6 months post-operatively in 29%. Only one

Table 1. Pre–Alveolar Bone Graft (ABG) Orthodontic Treatment Presented in Combinations and Individual Counts, as Reported by 31 Team Orthodontists. (1) Overall Results Are Compared With (2) Fellowship Training Status

Orthodontic Treatment Type	Responses, (%) n = 31	Fellowship, Yes (%) n = 17	Fellowship, No (%) n = 14	*P* Value
Combinations				.54
Maxillary/palatal expansion (to align alveolar segments/create space for grafting)	11 (35.5)	5 (29.4)	6 (42.9)	.44
Maxillary/palatal expansion (to align alveolar segments/create space for grafting), maxillary/palatal expansion (to correct posterior crossbite)	6 (19.4)	3 (17.7)	3 (21.4)	1.0
Maxillary/palatal expansion (to align alveolar segments/create space for grafting), maxillary/palatal expansion (to correct posterior crossbite), maxillary anterior tooth alignment with braces, anterior crossbite correction with braces and/or facemask	6 (19.4)	2 (11.8)	4 (28.6)	.37
Maxillary/palatal expansion (to correct posterior crossbite)	3 (9.7)	3 (17.7)	0 (0)	.23
Maxillary/palatal expansion (to align alveolar segments/create space for grafting), maxillary/palatal expansion (to correct posterior crossbite), maxillary anterior tooth alignment with braces	2 (6.5)	1 (5.9)	1 (7.1)	1.0
Maxillary/palatal expansion (to align alveolar segments/create space for grafting), maxillary/palatal expansion (to correct posterior crossbite), anterior crossbite correction with braces and/or facemask	1 (3.2)	1 (5.9)	0 (0)	1.0
Maxillary/palatal expansion (to align alveolar segments/create space for grafting), none	1 (3.2)	1 (5.9)	0 (0)	1.0
Other	1 (3.2)	1 (5.9)	0 (0)	1.0
Counts				
Maxillary/palatal expansion (to align alveolar segments/create space for grafting)	27 (87.1)	13 (76.5)	14 (100)	.11
Maxillary/palatal expansion (to correct posterior crossbite)	18 (58.1)	10 (58.8)	8 (57.1)	.93
Maxillary anterior tooth alignment with braces	8 (25.8)	3 (17.7)	5 (35.7)	.41
Anterior crossbite correction with braces and/or facemask	7 (22.6)	3 (17.7)	4 (28.6)	.67
None	1 (3.2)	1 (5.9)	0 (0)	1.0
Other	1 (3.2)	1 (5.9)	0 (0)	1.0

* Indicates statistical significance at $P < .05$.

orthodontist indicated performing tooth movement within 2 months post-graft (3.2%).

Fellowship Training Subgroups

Analysis of fellowship training status found no significant differences in pre-ABG orthodontic treatment type, post-ABG imaging timing relative to postoperative tooth movement, or post-ABG orthodontic treatment timing (Tables 1 through 3). Despite no statistical differences, numerical trends were observed. More than twice as many fellowship-trained orthodontists than non–fellowship trained orthodontists waited at least 6 months after grafting to initiate orthodontic treatment proximal to the graft (47.1% vs 21.4%, $P = .14$). Numerically more fellowship-trained orthodontists opted for greater delay in post-ABG orthodontic treatment, with more non–fellowship trained orthodontists selecting earlier initiation of treatment post-ABG. Within the fellowship group, twice as many delayed orthodontic treatment until at least 6 months post-graft than did those who began treatment 2–4 months or 4–6 months post-ABG (47.1% vs 23.5%).

DISCUSSION

This study describes the pre- and post-ABG treatment practices of orthodontists associated with ACPA-approved cleft palate and cleft palate/craniofacial teams in the United States who responded to a 2020–2021 survey. Other studies[13–15] have explored the billing and demographics of the orthodontic provider population among teams, but limited information has been reported regarding orthodontic treatment and timing preferences related to alveolar bone grafting.

Medial rotation of the alveolar segment(s) distal to the alveolar cleft(s) is often observed in complete cleft lip and palate, as illustrated in Figure 1. While posterior crossbite may exist, transverse arch constriction in the

Table 2. Timing of Post–Alveolar Bone Graft (ABG) Orthodontic Treatment in the Area of the Graft Relative to When Post-ABG Imaging Is Acquired, as Reported by 31 Team Orthodontists. (1) Overall Results Are Compared With (2) Fellowship Training Status

	Responses (%) n = 31	Fellowship, Yes (%) n = 17	Fellowship, No (%) n = 14	*P* Value
Post-ABG orthodontic treatment				1.0
Before acquiring post-ABG imaging	3 (9.7)	2 (11.8)	1 (7.1)	
After acquiring post-ABG imaging	28 (90.3)	15 (88.2)	13 (92.9)	

* Indicates statistical significance at $P < .05$.

Table 3. Timing of Post–Alveolar Bone Graft (ABG) Initiation of Orthodontic Treatment in the Area of the Graft, as Reported by 31 Team Orthodontists. (1) Overall Results Are Compared With (2) Fellowship Training Status

	Responses (%) n = 31	Fellowship, Yes (%) n = 17	Fellowship, No (%) n = 14	*P* Value
Post-ABG orthodontic treatment				.33
0–2 mo after graft	1 (3.2)	1 (5.9)	0 (0)	1.0
Between 2 and 4 mo after graft	10 (32.3)	4 (23.5)	6 (42.9)	.44
Between 4 and 6 mo after graft	9 (29.0)	4 (23.5)	5 (35.7)	.69
>6 mo after graft	11 (35.5)	8 (47.1)	3 (21.4)	.14

* Indicates statistical significance at $P < .05$.

anterior palate near the alveolar cleft may be more pronounced and contributes to alveolar segment rotational malalignment.[16] Most orthodontists in this study perform maxillary expansion to align alveolar segments before grafting. To achieve differential reorientation of the areas nearest the alveolar cleft, appliance design for pre-ABG expansion to align alveolar segments differs from traditional designs for posterior crossbite correction.[17] Common choices may be a W-Arch, quad helix, or Fan-type expander, the latter of which is shown in Figure 2. With ABG most commonly occurring in childhood, conventional bilateral expansion for posterior crossbite correction is still possible when done before sutural maturation.[18] It is important to note that expansion can increase alveolar cleft width or volume, which may affect graft outcome.[19,20] Therefore, orthodontists may consider deferring resolution of posterior crossbite until after grafting to avoid unnecessary enlargement of the alveolar cleft. Interestingly, more than half of responding orthodontists chose to correct posterior crossbite prior to ABG.

Approximately a quarter of respondents indicated that maxillary incisor alignment may be performed prior to ABG. Some classic orthodontic textbooks include alignment as part of pre-ABG preparation without specifying the goals of doing so.[21] Among the reasons pre-ABG alignment may be considered could be to optimize surgical access for grafting and accessibility for oral hygiene, esthetic improvement, or to relieve traumatic occlusion. Of concern, however, is that cleft-adjacent teeth often have pre-existing periodontal deficiency with compromised or limited bony support.[22] Orthodontic alignment adjacent to an ungrafted cleft may incur the risk of periodontal compromise in areas of minimal bony support, as shown in Figure 3. Studies are needed to evaluate the effects of pre-graft cleft-adjacent tooth alignment that clearly state the extent and goals of alignment in connection with their results.

More than one-fifth of respondents addressed anterior crossbite with fixed appliances and/or facemask prior to grafting. Facemask studies[23,24] have primarily focused on dentoskeletal effects, as evaluated by cephalometric analysis. Those initiating facemask treatment prior to alveolar bone grafting likely aim to harness the pliability of the sutures in early childhood to maximize protraction effects; those deferring facemask until after grafting may do so out

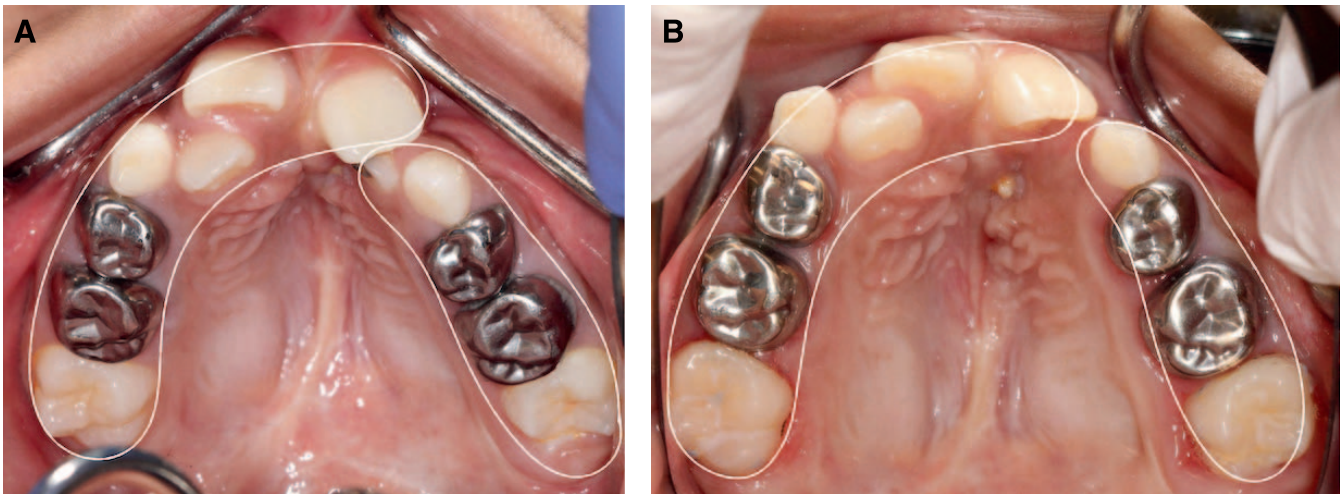

Figure 1. An 8-year-old patient with left unilateral alveolar cleft in orthodontic preparation for alveolar bone graft. (A) Prior to expansion, the lesser alveolar segment is rotated medially. (B) A W-arch was used to de-rotate the alveolar segments, improving alveolar segment relationships at the cleft.

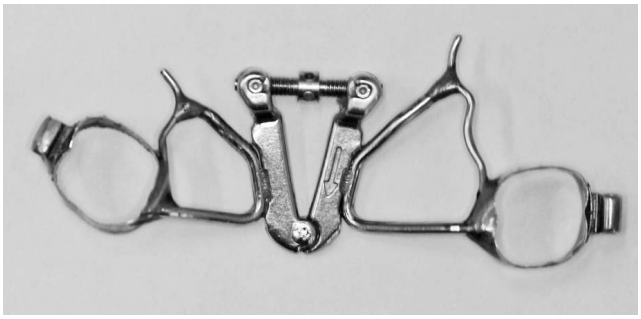

Figure 2. Fan expander, with activation screw near the anterior aspect of the hard palate to differentially expand the area of the alveolar cleft. This is in contrast to the screw position of a traditional Hyrax expander to address posterior crossbite, commonly located in proximity to the molars.

of concern for the discontinuous alveolar segments. It is also possible that some use the facemask to attempt to decrease the size of large alveolar clefts. Limited pre-ABG studies exist, with finite element analysis and simulations suggesting more displacement on the cleft side following facemask.[25,26] No studies directly evaluate the impact on the periodontium following pre-graft protraction facemask therapy. While maxillary incisor proclination is a known dental side effect, periodontal effects on the ungrafted cleft and cleft-adjacent teeth are unclear and warrant further investigation.

There appeared to be consensus to confirm graft status with post-ABG imaging prior to beginning orthodontic treatment. However, the results showed variability in the timing of post-ABG orthodontic treatment initiation, with nearly equal preference for 2–4 months, 4–6 months, and greater than 6 months post-operatively. In the literature, optimal timing to begin post-ABG orthodontic treatment has been debated. Overall, it appears that at least 3 months should elapse prior to beginning post-ABG orthodontic tooth movement, with some sources emphasizing longer periods of 6 months or more to permit additional maturation.[6,7,9,27] If tooth movement into a graft is performed before appropriate site healing and integration, there may be a risk to the tooth if the graft proves to be insufficient. Because graft success is multifactorial,[28,29] its failure can be due to reasons other than timing of post-ABG orthodontic treatment.

While significance was not reached in comparing fellowship training subgroups, it was interesting that fellowship-trained orthodontists trended toward delaying post-ABG treatment at least 6 months; this was noted when comparing to those without fellowship training and to others with fellowship training. Subgroup sample sizes were inadequate to detect statistically significant differences, and, therefore, definitive conclusions cannot be drawn.

Figure 3. Alignment of teeth adjacent to an ungrafted left unilateral alveolar cleft has resulted in loss of periodontal support for the maxillary left central incisor.

The results indicated a lack of consensus among orthodontists working with cleft/craniofacial teams and no clear evidence of consistent care protocols across orthodontic residency or craniofacial orthodontic fellowship training programs. Similarly, the existing literature is limited in providing robust evidence-based conclusions to aid practitioners in their decision-making. The large variation in pre-ABG treatment types from one to at least four interventions warrants a discussion in the provider community regarding burden of care, which is challenging to assess comprehensively without substantial literature support of care protocols. Regarding clinical training programs, although orthodontic residents recognize the importance of providing cleft and craniofacial care, they may feel inadequately prepared to do so with existing residency training.[30] Neither residents nor practicing orthodontists surveyed in 2009 expressed significant confidence in treating cleft/craniofacial cases or patients with special needs.[31] In a 2005 study,[14] 91% of responding orthodontists indicated they would feel more comfortable with treatment of cleft and craniofacial conditions with additional education. Further studies on pre- and post-ABG orthodontic treatment and timing would provide data to help support evidence-based treatment decisions and further the evolution of education in this important area.

Limitations

The results were limited to the 31 orthodontists who completed the survey. Findings may not reflect the practices of orthodontists affiliated with nonresponding teams. Results related to influence of fellowship should be interpreted with caution, as this subgroup already accounts for a smaller percentage of the overall orthodontist population.[10] A validated survey instrument does not exist in this topic area; therefore, the authors created questions based upon clinical inquiry. Factors of interest, such as appliance design and treatment mechanics, were beyond the scope of this survey.

CONCLUSIONS

- No consensus was observed in pre-ABG orthodontic treatment techniques. Maxillary expansion to align alveolar segments was the most reported treatment to prepare for grafting and may be done independently or in conjunction with other treatments.
- A near-equal distribution of orthodontists wait 2–4 months, 4–6 months, and at least 6 months postoperatively to initiate orthodontic tooth movement. It is prudent to conduct post-operative imaging to assess the graft and confirm sufficient bony support before orthodontic tooth movement in proximity to the grafted cleft.
- Evidence-based treatment protocols are overall lacking in the literature. Additional research is needed to support informed treatment decisions. Patient care and orthodontic training programs would benefit from the development and refinement of evidence-based approaches for orthodontic management of alveolar clefting.

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