Journal of Cranio-Maxillo-Facial Surgery 45 (2017) 479–484

Contents lists available at ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

Cephalometric comparison of early and late secondary bone grafting in the treatment of patients suffering from unilateral cleft lip and palate☆

Andrzej Brudnicki [a, *], Ewa Sawicka [a], Renata Brudnicka [b], Piotr Stanisław Fudalej [c, d]

[a] Department of Pediatric Surgery (Head: Prof. E. Sawicka), Institute of Mother and Child (IMC), Warsaw, Poland
[b] Department of Orthodontics (Head: Dr. A. Wierusz), Central Military Medical Outpatient Clinic CePeLek, Warsaw, Poland
[c] Department of Orthodontics and Dentofacial Orthopedics (Head: Prof. C. Katsaros), School of Dental Medicine, University of Bern, Switzerland
[d] Department of Orthodontics, Institute of Dentistry and Oral Sciences, Palacky University Olomouc, Olomouc, Czech Republic

ARTICLE INFO

Article history:
Paper received 17 August 2016
Accepted 11 January 2017
Available online 25 January 2017

Keywords:
Cleft lip and palate
Cephalometric
One-stage method
Early secondary bone grafting
Late secondary bone grafting

ABSTRACT

The study was based on a retrospective cephalometric assessment of 10-year-olds in order to evaluate the influence of early secondary bone grafting on craniofacial development in patients suffering from non-syndromic complete unilateral cleft lip and palate.

The study consisted of 79 patients in the early and 67 patients in the late secondary bone grafting group. The mean age at alveolar bone grafting was 2.5 years (SD 0.03) in the first group and 9.8 years (SD 2.3) in the second group. The primary cleft repair of these 146 patients was always performed in accordance with the one-stage method. Additionally, the non-cleft Control group was comprised of 56 children of the same ethnicity and age.

The cephalometric analysis performed at age 10 revealed similar overall characteristics of observed growth disturbances in both cleft groups in comparison to the Control group, such as: inhibition of vertical and anterior maxillary development, the tendency of the mandible to rotate clockwise, and a prevalence of vertical over horizontal facial growth. The comparison between the cleft groups revealed a lack of growth differences in the vertical dimension and more pronounced anterior maxillary development inhibition in the early bone grafting group.

This study will be followed by a similar evaluation after craniofacial development is complete by a significant number of these patients in order to ascertain our conclusions.

1. Introduction

At the moment, bone grafting is undoubtedly recognized as an integral element of contemporary surgical protocols when treating cleft defects that affect the alveolus, and its numerous benefits have often been repeated in the literature.

It is important to clarify the meaning of the terms *primary* and *secondary,* as well as *early* and *late* bone grafting. Although there is no consensus about the existing terminology, secondary bone grafting principally implies that the procedure was performed after cleft palate repair while primary bone grafting indicates that the procedure was performed before or during palatoplasty, usually at the time of nasolabial closure (Eppley, 1996; Tatum and Ness, 1996; Rosenstein, 2003). Therefore, these terms relate to the surgical context of the procedure in the cleft treatment protocol, while *early* and *late* relate rather to the age of a patient at the moment of the bone grafting procedure. According to Larsen (2004), the procedure is *early* when performed up to the 6th year of life (during deciduous dentition) and *late* when a patient is older (during mixed or permanent dentition). In this sense, the phrase 'early secondary bone grafting' used by the authors of the present study should be regarded as the procedure performed after completing the primary cleft repairs, but before the 6th year of life.

It seems nowadays that secondary bone grafting is generally preferable and regarded as more advantageous for the craniofacial development method of treatment over primary bone grafting. There were articles published long ago to prove this (Rehrmann

☆ The study was performed as part of a major statutory project of the Department of Pediatric Surgery of IMC.

* Corresponding author. Department of Pediatric Surgery, Institute of Mother and Child, Kasprzaka Street 17a, 01-211 Warsaw, Poland. Fax: +48 22 327 73 84.
E-mail address: andrzej.brudnicki@imid.med.pl (A. Brudnicki).

http://dx.doi.org/10.1016/j.jcms.2017.01.016
1010-5182/

et al., 1970; Friede and Johanson, 1974; Robertson and Jolleys, 1983), however, the differences between primary and secondary bone graftings that were described in the literature applied not only to the timing, but also to their surgical technique as well. Hence, maxillary growth inhibition resulting from primary bone grafting could not be attributed unambiguously only to the early timing of this procedure. To the best of our knowledge, the literature appears to be devoid of cephalometric evaluations of patients treated by secondary bone grafting performed long before the timing recommended by Boyne and Sands (1972), in particular among patients younger than 6 years of age.

The aim of this study was to evaluate, via cephalometric analysis, the influence of the early secondary bone grafting on craniofacial development of the patients suffering from UCLP.

2. Materials and methods

2.1. Patients

This was a retrospective assessment of 10-year-olds suffering from non-syndromic complete UCLP, who were consecutively treated by the cleft team of IMC between 1994 and 2003, according to the same one-stage method of primary cleft repair. Inclusion criteria were as follows: primary cleft repair performed at end of the first year of life (as recommended by our treatment protocol), all surgical treatment took place exclusively at the IMC, and patients have full medical documentation including lateral cephalograms taken at follow-up around the 10th year of life.

Additionally, a Control group was established on the basis of orthodontic medical records of healthy children of Polish ethnicity without clefts. The inclusion criteria for this group were: having an X-ray examination done around the 10th year of life, first class of molar relation, absence of cross-bite, scissor-bite or open-bite, and no history of previous orthodontic treatment.

2.2. Surgical technique

No presurgical orthodontic treatment was carried out in any of the patients in the study whatsoever. Preoperative antibiotics were given to all patients intravenously and continued for 4–5 days postoperatively – *ceftriaxone* was routinely administered.

The primary cleft operation consisted of palatoplasty of both the hard and soft palate and cheiloplasty by the modified Tennison-Randall method carried out during the same surgery. The surgical technique of this one-stage method was recently described more closely in the literature (Fudalej et al., 2010; Brudnicki et al., 2014a). The surgical technique of alveolar bone grafting was principally performed in accordance with that described by Hall and Posnick (1983) and remained the same regardless of the age of the patient or operating surgeon. Any credible differences were rather connected to the severity of each individual case or the need for coexisting alveolar oronasal fistula closure. Bone grafting was always carried out with a cancellous bone block fixed firmly between the bony edges of the cleft fissure and covered by gingival mucoperiosteal flaps. As a rule of thumb, the bone tissue was always harvested from the anterior part of the iliac crest.

Both the primary cleft operations and bone grafting procedures were performed by 4 surgeons belonging, at that time, to the cleft team at IMC. Not all of the patients were operated by the same surgeon during the following stage of the surgical protocol.

2.3. Methodology

The presented study was granted ethics approval by the Bioethics Committee of the IMC in October, 2013. The surgeons responsible for the primary cleft lip and palate repair, or alveolar bone grafting, were not involved in any part of the evaluation described in the study. The cephalograms were evaluated at random by an orthodontist who was not aware of their group affiliation.

The information database about subsequently operated patients and the procedures which took place in the Operating Theatre of the IMC was the Theatre Register. The obtained patient data were verified, completed and duly extended according to their medical records. The following variables were recorded: gender, cleft type, location of alveolar defect being repaired, identity of surgeons, and patient age at primary cleft repair, at bone grafting and at cephalometric examination.

Craniofacial morphology was analyzed on lateral cephalograms taken in centric occlusion at follow-up appointments around the 10th year of life. The collected cephalograms were digitalized and then imported into the Dolphin 11.5 Imaging software program (Dolphin Imaging & Management Solutions, USA). A scaled calibration was always the first step before identifying cephalometric landmarks in this program. Image enhancement features, such as brightness, contrast adjustment and high magnification, were used for better landmark identification. The cephalometric landmarks used in the study are presented in Fig. 1.

The set of measurements prepared for cephalometric analysis of this study was initially very complex, and therefore the study was simplified and finally limited to several of the most relevant skeletal measurements only. These measurements applied to: the skull base, the vertical relations of the elements of the facial part of the skull, the horizontal position and development of the maxilla, the vertical position and morphology of the mandible, the mutual relation of the maxilla and mandible in the antero-posterior plane and the occlusal relations. The cephalometric measurements used in the study are described in Table 1.

2.4. Statistical analysis

For all statistical calculations, Statistica 10 software (StatSoft, USA) was used. Paired *t* tests were used to compare the mean values of cephalometric measurements of the cleft groups – ES-ABG and LS-ABG with the Control group, and then with each other. The minimum level at which the test would be judged significant was $P \leq 0.05$. The method error for each measurement was calculated by Dahlberg's formula (Houston, 1983) after determining differences

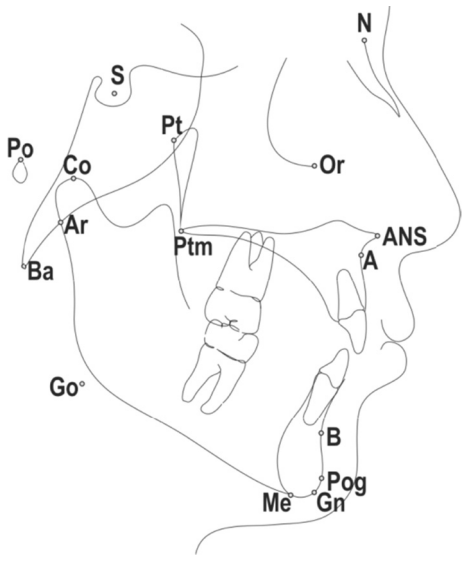

Fig. 1. Cephalometric landmarks used in the study.