



METHODS OF PLASTIC SURGERY OF THE ALVEOLAR PROCESS IN CHILDREN WITH CONGENITAL CLEFT LIP AND PALATE

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Abstract. Alveolar cleft is a tornado-shaped bone defect in the maxillary arch. The treatment goals for alveolar cleft are stabilization and provision of bone continuity to the maxillary arch, permitting support for tooth eruption, eliminating oronasal fistulas, providing an improved esthetic result, and improving speech. Treatment protocols vary in terms of the operative time, surgical techniques, and graft materials. Early approaches including boneless bone grafting (gingivoperiosteoplasty) and primary bone graft fell into disfavor because they impaired facial growth, and they remain controversial. Secondary bone graft (SBG) is not the most perfect method, but long-term follow-up has shown that the graft is absorbed to a lesser extent, does not impede facial growth, and supports other teeth. Accordingly, SBG in the mixed dentition phase (6–11 years) has become the preferred method of treatment. The most commonly used graft material is cancellous bone from the iliac crest. Recently, many researchers have investigated the use of allogeneic bone, artificial bone, and recombinant human bone morphogenetic protein, along with growth factors because of their ability to decrease donor-site morbidity. Further investigations of bone substitutes and additives will continue to be needed to increase their effectiveness and to reduce complications.

Keywords: alveolar bone grafting, alveolar process, congenital cleft lip and palate.

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МЕТОДЫ ПЛАСТИЧЕСКОЙ ОПЕРАЦИИ АЛЬВЕОЛЯРНОГО ОТРОСКА У ДЕТЕЙ С ВРОЖДЕННОЙ РАСЩЕЛИНОЙ ГУБЫ И НЕБА

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Аннотация. Альвеолярная расщелина представляет собой торнадообразный дефект кости в верхней челюсти. Целями лечения альвеолярной расщелины являются стабилизация и обеспечение целостности костной ткани верхней челюсти, обеспечение поддержки при прорезывании зубов, устранение ороназальных свищей, улучшение эстетического результата и улучшение речи. Протоколы лечения различаются в зависимости от продолжительности операции, хирургических методов и трансплантационных материалов. Ранние подходы, включая бескостную пластику кости (гингивопериостопластику) и первичную костную пластику, оказались в неудачными, поскольку они нарушали рост лица, и остаются спорными. Вторичная костная пластика (ВКП) не самый совершенный метод, но длительное наблюдение показало, что трансплантат приживается в меньшей степени, не препятствует росту лица, поддерживает другие зубы. Соответственно, ВКП в фазе сменного прикуса (6–11 лет) стала предпочтительным методом лечения. Наиболее часто используемым материалом для трансплантации является губчатая кость из гребня подвздошной кости. В последнее время многие исследователи исследовали использование аллогенной кости, искусственной кости и рекомбинантного морфогенетического белка человеческой кости вместе с факторами роста. Дальнейшие исследования костных заменителей и добавок будут необходимы для повышения их эффективности и снижения осложнений.

Ключевые слова: альвеолярная костная пластика, альвеолярный отросток, врожденная расщелина губы и неба.

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THE URGENCY OF THE PROBLEM

CLP from the first days of a child's life is accompanied by severe anatomical and functional

disorders and requires complex treatment. One of the important tasks that the surgeon has to solve in the process of eliminating this defect of the

maxillofacial region is to restore the continuity of the alveolar process of the upper jaw. The problem of preventing deformities of the upper jaw is very relevant and has not yet been fully resolved, which justifies the search for new, more rational methods of treatment.

One of the methods for preventing the development of secondary deformities of the dentoalveolar system, along with various methods of surgical intervention and orthodontic treatment, is the use of bone grafts in the elimination of cleft alveolar process (CAP).

A significant number of works are devoted to this issue both in domestic and foreign literature (1, 2, 3, 4).

At the same time, the authors set themselves the following goals: restoration of anatomical integrity, prevention of shortening of the alveolar arch, replenishment of bone deficiency, stabilization of fragments of the alveolar process, migration of the rudiments of teeth into the formed bone, correct formation and further growth of the upper jaw, as well as the elimination of aesthetic defects - the exclusion of anomalies the position of the teeth in the frontal area, the retraction of the soft tissues of the lip and nasal passage, the flattening of the wing of the nose. In addition, the restoration of the continuity of the alveolar process creates favorable conditions for the growth and development of the entire middle zone of the face.

Despite the fact that the restoration of a congenital defect of the alveolar process has a long history and a large number of works by domestic and foreign authors are devoted to solving this problem, many issues regarding the treatment and rehabilitation of patients with this pathology remain controversial to this day.

- age at which surgery should be performed;
- type of bone graft and area from which donor bone tissue should be taken;
- the need and time of maxillary protrusion (before or after bone grafting).

Depending on the timing of the intervention, bone grafting is usually divided into primary, performed at the time of cheiloplasty [5-12] and secondary, performed after cheiloplasty. Secondary bone grafting, in turn, is divided into early, carried out during the period of milk occlusion, and late, carried out in combination with corrective operations on the upper lip and nose during the formed permanent occlusion [13-18].

The first attempts to fully eliminate COP in patients

with CCLP have been known since the end of the 19th century. Eiselberg suggested using a "complex graft" - the fifth finger of the patient's left hand. Beck, Yesser (1921) tried to cover the bone defect with the bone of the nasal concha, which was turned towards the defect on the feeding pedicle from the mucous membrane. Later I.V. Berdyuk (1963) used the inferior turbinate to eliminate RW. Veau attempt (1931) failed to restore the continuity of the palatine bones with shavings from the patient's tibia [19, 20].

P.P. Lvov, A. A. Limberg (1939), Axhausen (1952) proposed to restore the continuity of the alveolar process of the upper jaw by moving the mucoperiosteal flaps along the edges of the cleft, but also without noticeable success.

The first to successfully restore the continuity of the alveolar process in children after cheiloplasty Schmid, (1955). They were transplanted pieces of the iliac crest, which prevented the convergence of the fragments of the upper jaw under the influence of the pressure of the restored upper lip. The positive effect of bone grafting has been confirmed in studies by Schrudde, Stellmach (1959), Brauer, Cronin (1964), Reichert (1969), Matthews et al., (1970) and others, who showed that free transplantation of a rib fragment into an alveolar process defect prevents shortening of the dental arch, narrowing of the upper jaw, and promotes fixation and restoration of the function of the premaxillary bone.

When applying osteoplasty, most researchers used autologous material (rib, ilium and tibia) as grafts. Pieces of a whole or split rib were used [20-25] The elimination of COP by iliac crest transplants is considered by a number of authors as the method of choice [26]. Recently, bone and cartilage grafts of the rib or ilium are more often used, which, according to the authors, have growth zones and subsequently grow synchronously with the growth of the patient [26].

In the vast majority, secondary bone grafting [27, 28]. The most widely used graft is the iliac crest. Basically, this surgical intervention is performed in the period from 6 to 14 years, emphasizing that after the age of 14 the results are less satisfactory. Moreover, from the point of view of orthodontic practice, the optimal time for bone transplantation is the period when the permanent lateral incisor or canine adjacent to the cleft is covered with a thin layer of bone tissue, i.e. at the age of 7-9 years [29].

G.G. Kryklyas (1965) conducted a comparative analysis of rib auto- and allografts placed in an artificially created COP using X-ray and

morphological methods. The data obtained indicate that the process of transplantation and healing in both cases is similar, however, the restructuring of the allograft proceeds more slowly and is accompanied by a less pronounced formation of new bone. In the clinical use of allogeneic ribs in 19 patients and allogeneic cartilage in 7 patients, the author observed sequestration and resorption of bone seedlings in 2 patients 3 and 9 months after surgery.

The methods of osteoplastic elimination of RW differ in the form of seedlings, the number and type of their transplantation into the fissured defect. Most of the authors performed the first bone grafts with a split piece of the patient's rib "into the overlay". The bone graft was introduced into the subperiosteal pockets formed along the edges of the COP [30]. Kriens (1968), Bertz (1981) and others recommend wedge-in pieces of the ilium along the entire height of the COP, filling the empty areas with bone chips. Widmaier (1966), Schuchardt (1966) and others. The ends of the bone graft were formed in the form of a dovetail and placed in a spacer between the edges of the defect.

Primary bone grafting is mainly used in children in the first year of life. L.E. Frolova (1967) recommends performing bone grafting in newborns in the first 2 weeks or after 3 months. Jolleys, Robertson (1972), Pfeifer (1972) and others consider the operation to be 3-5 months optimal. In most domestic and foreign clinics, cheiloplasty with bone grafting of the alveolar process is performed at 6-8 months (G.I. Semenchenko, 1970; Yu.S. Zakharov, G.N. Ruzin, 1974; G. G. Mamedov, 1978; Hoppe, 1977; Hrivnakova et al., 1981, 1983 and others). According to Eppley, Sadove (2000) primary bone grafting using a rib favorably affects the growth and development of teeth and the upper jaw itself, eliminates the oronasal fistula, and also prevents the collapse of split jaw segments. There are also reports of unsatisfactory results of bone grafting with a rib autograft in patients aged 15 months with COP at the base of the wing of the nose (Robertson, Jolleys, 1968). Performing primary rhinocheilognatoplasty in children older than 6 months. using lyophilized bone and autopsplings of the periosteum of the tibia, B.N. Davydov (1984) obtained good results in 84.8% of cases. Only 15.2% managed to achieve only partial elimination of the defect, however, even a partial increase prevented flattening of the upper lip and nose. The author managed to achieve the best results with secondary

bone - periosteal plasty of COP: in 90.9 % of cases, complete elimination of the defect was observed, in 9.1% - partial.

An important moment of the operation, which largely determines the outcome of treatment, is the formation of a soft tissue bed for the graft. G.I. Semenchenko (1963) and L.E. Frolova (1980) uses flaps of the mucous membrane of the edges of the RVG to form a bed, sparing the periosteum of the upper jaw, exfoliating it only to introduce the ends of the graft. Foreign surgeons, as a rule, take a more radical approach to the formation of a soft tissue bed. Muco - periosteal flaps from the vomer according to Stellmach are used, mucoperiosteal flaps are overturned from the premaxillary bone and a small fragment of the upper jaw. Delaire et al. (1988) in addition to the flap from the vomer, the periosteal flap is peeled off and overturned from the anterior surface of the upper jaw, the integrity of the entire alveolar process and the anterior hard palate is restored.

Most authors with experience in primary bone grafting indicate that bone grafts can eliminate the deforming effect of the restored upper lip on the split upper jaw. Less effective in this regard are seedlings implanted in the lining, they only slow down the displacement of fragments after cheiloplasty. Such plastics can be successful when combined with postoperative orthodontic treatment [31-35].

The continuity of the alveolar process improves the conditions for eruption and formation of the anterior teeth, the entire anterior part of the upper jaw. G.I. Semenchenko (1964, 1970), Johanson, Ohlsson (1961), Scoog (1965), Wood (1970) and others observed the displacement of the rudiments of the teeth into the graft and their eruption. Having received good immediate results in the elimination of a bone defect in the alveolar process, the authors expressed reasonable hopes for the correct and symmetrical growth of the upper jaw during its further development. However, in assessing the long-term results of primary bone grafting, there is no such unanimous opinion.

G.K. Semenchenko (1970), observing patients for more than 10 years, notes that the upper jaw after rib autograft plasty in the area of the piriform opening and COP develops well, the deformation of the middle part of the face is eliminated, and the front teeth erupt in a more correct position. At the same time, the author points out the need for orthodontic treatment and prevention of false progeny.

Reichert (1969), based on a survey of 450 children aged 7-8 years with unilateral and bilateral CCLP, who had previously undergone primary plasty with bone and cartilage grafts of the ilium, indicated that the bite in most patients was correct. In addition, the author considers primary bone grafting using a rib to be very useful in the complex treatment of patients with facial cleft. Wood (1970), studying the 5-year long-term results of treatment of children, indicates the positive role of bone grafting in the growth of the upper jaw [36-40].

Hathaway et al. (1999) compared two groups of patients aged 8 years: those who underwent primary bone grafting and the group without bone transplantation. In the first group, retrusion of the upper jaw, open bite and vertical craniofacial shortening were often noted. However, the authors emphasize that the changes found were not generalized and occurred only in some patients.

Smahel et al. (1998) analyzed the results of various methods of COP treatment in 84 patients and concluded that the use of the method of primary bone grafting leads to a deterioration in the growth of the anterior part of the upper jaw.

Rehrmann, Koberg, Koch (1970) conducted a thorough comparative analysis of the state of the dento-jaw system in 100 children aged 9 years. In 50 of them, COP was eliminated in the first 6 months, while a rib autograft was used. Given that surgical interventions on the soft tissues of the lip, hard and soft palate were the same in the compared groups of patients, the authors concluded that the seedling had an adverse effect on the growth of the upper jaw. The bone seedling after transplantation and engraftment decreases in size and lags behind in growth compared to the surrounding tissues.

Similar data were obtained when studying the long-term results of primary bone grafting (Robertson, Jolleys, 1968; Jolleys, Robertson, 1972; Harle, Duker, 1973). Jolleys performed early secondary bone grafting, as he considers primary bone grafting at 2 months to be life-threatening. According to Jolleys, bone grafting can be successful only when bone and cartilage grafts are used, including the growth zone.

Hrivnakova et al. (1983), summarizing the long-term experience of treating 245 patients with COP using autologous bone from the rib, noted the positive effect of eliminating the defect on the growth of the upper jaw, reducing the frequency of dento-jaw deformities and improving the conditions

for orthodontic treatment. Similar data were also obtained by Schmid et al., (1973), Epapu (1981) and others.

There are no reliable data in the literature on the improvement of the state of the dentoalveolar system after performing early secondary bone grafting at the age of 4-5 years. The authors consider it expedient only late bone grafting after the eruption of permanent teeth. However, in the work of B.N. Davydova (1984) noted the favorable effect of primary and early secondary bone grafting of the alveolar process with a combined bone-periosteal graft on the growth of the upper jaw and the middle zone of the face. In addition, the reconstructed alveolar process provides stable cosmetic and functional results of correction of the lip-nose-alveolar process complex.

The Scoog method is widely used (1965), according to which the integrity of the anterior part of the maxilla is restored with an extensive periosteal flap cut out on the anterior surface of a small fragment of the maxilla with a feeding pedicle in the region of the nasal bridge and infraorbital margin. The lining from the vestibule of the cavity is formed according to Veau - Axhausen. A hemostatic sponge "surgicel" is placed under the exfoliated periosteal flap, which causes activation of bone formation and restoration of the integrity of the alveolar process and the edge of the piriform opening. Without preoperative orthodontic treatment, this technique allowed Scoog get good results.

About the successful use of the Scoog methodology reported by Koberg (1973), Rosseli, Standoli (1972), Prydso et al. (1974) and others. Hrivnakova et al. (1983) observed the growth of the upper jaw in 183 patients operated on by the Scoog method. The authors note an improvement in the growth of the upper jaw and a decrease in dento-maxillary anomalies. In 75% of patients, the continuity of the bone of the alveolar process was restored, in 25% - a decrease in the bone defect.

There are also more cautious opinions about the effectiveness of this method. Ritsila et al. (1972) received only 54% of good results, where bone formation and restoration of the integrity of the alveolar process took place. Nappi, Lehman (1980) in the clinic and experiment did not confirm the enhancement of osteogenesis when using the hemostatic sponge "surgicel".

Ritsila et al. (1972) consider it more expedient to eliminate COP with free periosteal flaps borrowed

from the anterior surface of the patient's tibia. In 88.5 % of patients the periosteum gave bone formation, in 77% it covered the alveolar process with dense bone tissue. The effectiveness of this method is confirmed by the work of Strieker et al. (1977), Rosseli (1982).

Dento -jaw system in patients with COP were obtained by Sitzmann than with bone graft plasty (1979), who applied an original method of eliminating COP with a mucoperiosteal flap from the alveolar process of a small fragment of the upper jaw.

Despite the convincing figures and objective indicators carried out by the authors on the growth of the upper jaw of patients operated on by the Scoog method or Sitzmann, their invasiveness, extensive detachment and damage to the periosteum of a small fragment, which probably cannot be indifferent to the growth of an underdeveloped, stunted lateral fragment of the upper jaw, are alarming. Research carried out by Hrivnakova et al. (1983) show that the periosteum of the upper jaw does not completely regenerate at the site of its detachment.

Azzolini et al. (1982) reported the successful use of free periosteal grafts in the elimination of COP and palate with good long-term results in the postoperative development of the nose and maxilla.

According to L.V. Ageeva, G.M. Savitskaya, V.V. Roginsky (1997), the use of the periosgeoplasty method during primary cheilorhinoplasty (at the age of 4-5 months) brings good long-term functional and cosmetic results. Periosteoplasty, according to the authors, is based on the following premises:

- the periosteum covering the upper jaw has a normal growth potential;
- exposed upper jaw regenerates the periosteum; periosteal flap is displaced relative to the cleft, its osteogenic possibility is realized: extensive mobilization of the periosteum can be carried out without damaging the bone sutures and growth zones;

- Periosteoplasty is most effective in childhood.

Santiago et al. (1988) 18 patients in infancy used the following treatment method: in the preoperative period, the modeling of the alveolar process of the upper jaw using an orthodontic plate, followed by primary gingivoperiosteoplasty. This allowed 60% of patients to avoid secondary bone grafting during mixed dentition.

There was no consensus on the optimal types of osteoplastic →replacement at the International

Congress on Facial Cleft and Concomitant Traumatic Anomaly (USA, Florida 2013).

Controversial opinions about the results of periosteoplasty were also presented at the congress. A promising direction in the use of autoplasty of a congenital defect is noted. Congress noted the low efficiency of alloplasty in primary bone grafting. However, domestic clinics report the successful use of cadaveric bone in the replacement of congenital defects (LE Frolova et al., 1979; V.I. Vakulenko, 1982, etc.).

Hoppe (1977) successfully uses the " keel bone" to stimulate osteogenesis of the cleft margins. However, these works do not provide objective data on the restructuring of allografts, on an increase in bone growth along the edges of the cleft.

Thus, the analysis of literature data showed that bone grafting of the COP at the time of cheiloplasty is a widespread method of treating patients with CCLP. At the same time, the optimal variant of osteoplastic →elimination of a congenital defect has not yet been determined. The success of the treatment mainly depends on two conditions: the operation must be performed with minimal trauma to the upper jaw, and the bone regenerate, restoring the integrity of the alveolar process, must retain the ability to actively restructure and increase with age.

The most complete results were obtained with transplantation of autologous bone and, above all, bone and cartilage grafts. However, autotransplantation in infancy has a significant drawback: an additional operation to take the autograft significantly complicates the first stage of surgical treatment.

Allografts for full engraftment (restructuring) require the creation of a periosteal bed, the formation of which is associated with additional trauma to the upper jaw.

There are reports indicating high immediate and long-term results of periosteoplasty in children with a congenital defect of the upper jaw with a flap of the periosteum of the upper jaw on a feeding leg or free seedlings of the periosteum of tubular bones.

However, with this method of "non-bone" plastics, there is no direct orthopedic effect. In addition, bone regenerate is formed a few months after transplantation, and the first months after the operation, the deforming effect of the restored lip on the split upper jaw is possible.

Thus, the above data indicate that each type of transplant has certain disadvantages, which

in the future can lead to a complicated course of the postoperative period. Accordingly, it is quite justified to search for and develop new methods and materials that allow achieving a satisfactory level of regeneration in the area of the defect in the bone tissue of the alveolar process of the upper jaw.

CONFLICT OF INTERESTS

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All authors contributed to the design and interpretation of the study and to further drafts. All authors read and approved the final manuscript.

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КОНФЛИКТ ИНТЕРЕСОВ

Авторы заявляют, что данная работа, её тема, предмет и содержание не затрагивают конкурирующих интересов.

ИСТОЧНИКИ ФИНАНСИРОВАНИЯ

Авторы заявляют об отсутствии финансирования при проведении исследования.

ДОСТУПНОСТЬ ДАННЫХ И МАТЕРИАЛОВ

Все данные, полученные или проанализированные в ходе этого исследования, включены в настоящую опубликованную статью.

ВКЛАД ОТДЕЛЬНЫХ АВТОРОВ

Все авторы внесли свой вклад в подготовку исследования и толкование его результатов, а также в подготовку последующих редакций. Все авторы прочитали и одобрили итоговый вариант рукописи.

ЭТИЧЕСКОЕ ОДОБРЕНИЕ И СОГЛАСИЕ НА УЧАСТИЕ

Были соблюдены все применимые международные, национальные и/или институциональные руководящие принципы по уходу за животными и их использованию.

СОГЛАСИЕ НА ПУБЛИКАЦИЮ

Не применимо.

ПРИМЕЧАНИЕ ИЗДАТЕЛЯ

Журнал *"Интегративная стоматология и челюстно-лицевая хирургия"* сохраняет нейтралитет в отношении юрисдикционных претензий по опубликованным картам и указаниям институциональной принадлежности.

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