

The Effect of Acellular Dermal Matrix on the Success of Primary Palatoplasty With Intravelar Veloplasty

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Abstract

Background

Acellular Dermal Matrix graft is usually used to repair fistulas following a cleft palate and has had positive results. But its use for primary palatoplasty has been less studied. Our aim was to compare the usefulness of using Acellular Dermal Matrix transplantation for primary palatoplasty with intravelar veloplasty in contrast to its lack of use

Materials and methods

A total of 72 children (6 months to 6 years old) with cleft palate were included in the study. The case-control prospective observations were conducted. A group underwent primary palatoplasty with intravelar veloplasty using Acellular Dermal Matrix and the control group had the same surgery without using Acellular Dermal Matrix. Patients were monitored for fistula formation, post-operative infection, and ulcers.

Results

No post-surgical infection and wound opening was seen in any group. In the recipients of Acellular Dermal Matrix and control group three and six fistula was reported in which patients had soft and hard palate involvement and the cleft with length greater than 15 mm.

Conclusions

Considering the double incidence of fistulas in the control group compared to the ADM recipient, it seems that the use of ADM can be effective in reducing the incidence of fistulas. Since fistula is one of the complications of primary palatoplasty surgery and leads to secondary surgeries, the use of ADM can be helpful.

Background

The surgical procedure used to correct or repair a palate in a person with cleft palate is called palatoplasty (1). The primary goal is to close the cavities between mouth and nose so that patients could have natural speaking (2), ingestion, respiration, and development of structures in their mouth (2, 3). Palatoplasty could be used for any degree of cleft palate. This surgical procedure is usually operated on infants with the ages between 6 to 12 months as the most suitable ones (4). Following the closure of the palate layers, an intravelar veloplasty is performed to correct and change the position of the palatal muscles (5). Because of the improvements in palate performance, the patient's complaint about the complications decreases (6, 7). If palate reconstruction is successful, the velopharyngeal area closes completely and the patient obtains the proper speech capability (6). Although it has not yet been fully scientifically proven, it seems that palatoplasty may reduce the chance of patients with cleft palate to have middle ear inflammation and develop deafness (2). Various techniques including local

mucoperiosteal flap, V-Y two-layer repair, superior lip mucosal or myomucosal flap, buccal myomucosal flap, superiorly based facial artery myomucosal flap, tongue flap, free flap, free cartilage graft, Distraction Osteogenesis, Acellular Dermal Matrix have been reported for cleft palate (8-10).

Fistula, infection and bleeding are the complications reported after cleft palate repair (11). The criteria for the successful palatoplasty is the absence of oronasal fistula formation (12). Factors leading to the occurrence of fistula include the width of the cleft, the technique used in the surgery, the inappropriate repair of the cleft, the inappropriate selection of the suture region and thus the pressure on the area, age and gender of the patient during surgery (13). After primary palatoplasty, the primary palatal fistula formation with the probability of 0 to 67% and recurrence of about 25–100% were reported. If the cleft palate is closed with the epidermal mucus flaps, the probability of recurrence of forming fistula is higher (14).

Medical researchers have proposed various methods to reduce fistula formation including the use of buccal flaps (14), bone grafting (15), buccal myomucosal flap (16) Buccal fat pad flap (17), buccal mucosal flap (18), and high growth factor (PRGF) plasma (19).

Acellular Dermal Matrix is widely used in multiple plastic surgeries (20). Acellular matrices have different usages including their potential role in the regeneration of organs or tissues. The ability to mimic the physiological conditions in the microscopic environment of the recipient tissue is one of the advantages of using these matrices (21). Once ADM is used in transplantation, it acts as a scaffold for the implantation of the recipient's cells and facilitator of subsequent adhesions and angiogenesis. These natural scaffolds are used in the manufacture of artificial limbs and tissue repair and could be considered a solution to one of the biggest medical challenges from organ failure to plastic surgeries (22).

Acellular Dermal matrix (ADM) is derived from the dermis, which is soft tissue. During the process of decellularization, the skin extracellular matrix structure is retained. This skin graft does not lead to immune response stimulation due to its lack of cells; therefore, patients do not require to receive high doses of immune system suppressors. As a result, they are used in initial closure of wide openings in soft and hard tissues such as cleft palate and lip (23).

In recent years, Acellular Dermal Matrix has been used to repair the cleft palate fistula (24); however, use of this tool for primary palatoplasty has been less studied. In addition, in few previous studies generalized results have not been reported due to small sample size. Therefore, there is a need for further studies (25). The present study was designed to investigate the usage and effect of alloderm in the early stages of palatoplasty. The result help in improving the quality of life of patients with Cleft pallet.

Materials And Methods

This research is a case-control, prospective observational study. The participants were the patients who were referred to the Cleft palate clinic of Isfahan University of Medical Sciences. After being examined by

the experts, they were registered for the primary palatoplasty. Inclusion criteria were having ages between 6 months to 6 years old and cleft palate Veau classes II to IV. Exclusion criteria were parents' unwillingness to give consent, diagnosis of a craniofacial syndrome, a disorder such as Ehlers Danlosus Syndrome and Pseudoxanthoma elasticum which are characterized with wound healing defect, and the Veau class I cleft palate.

All children referred to Alzahra University Hospital in Isfahan who had inclusion criteria were divided into two groups: primary palatoplasty with ADM and other primary palatoplasty procedures.

Ethical considerations of this study were the willingness of patients to participate in the study. Patients were assured that if they did not want to participate in the study, no changes will be made in their treatment plan. Written consent was obtained from patients' parents. The consent allowed us to use the information recorded in the medical documents if necessary. Patients were assured that only de-identified information will be published. Patient information was recorded in a checklist containing patient characteristics, type of surgery, type of cleft, presence or absence of fistula, infection, hemorrhage and hematoma. The results were analyzed using SPSS version 16 and Chi-square statistical test.

Palatoplasty Method

All surgical procedures were performed under general anesthesia through the general tracheal tube with topical injection of lidocaine 1% with 1:100,000 epinephrine as well as the dose of first-generation cephalosporin for prophylaxis (cefalotin 50 / kg in children and 1 g / IV in adults). Then, the location of the cleft palate in the oral mucosa on the bone surface of the palate was separated from nasal part by the surgeon. In the next step, the palate mucoperiosteal flap covered the cleft flap and about 2 to 3 mm of it, and was prepared as a pocket for Acellular Dermal Matrix. Then the alloderm was used which was usually a thin piece with a thickness of 0.33-0.76 mm (Figure 1). The alloderm was placed around the cleft palate and below the surface of the mucoperiosteum flap was sutured with vicryl or monocryl 4.0. For 36 patients in the study group alloderm, and for 36 patients in the control group the same method without alloderm was used. Patients were followed up 6 months after their recharge from hospital. The width of the cleft palate was defined using the Veau classification.

Recommended care after primary palatoplasty were oral antibiotic therapy, using chlorhexidine mouthwash for one week and a diet containing drinks and soft foods for three weeks after the palatoplasty.

Results

A total of 72 patients with cleft palate were referred to Alzahra University Hospital for primary palatoplasty in 2017. Patients were 32 girls and 40 boys (16 girls and 20 boys in each group) 6 months to 6 years old (patients' age in control group ranged from 6 months to 3 years and in ADM recipient group 6 months to 6 years). Other information such as cleft palate size, type, and duration of hospitalization is

available in Table 1 none of the patients were excluded from the study. Patients were monitored for 6 months following the primary palatoplasty. They were examined for fistula formation, postoperative infections and wound dehiscence (Table 2).

Table 1
Frequency of Cleft Palate Size, type and Time of hospitalization in two groups of patients by type of surgical method.

Surgery type		ADM	Other types except ADM
Cleft Palate Size	Small(Less than 5 mm)	1	1
	Medium (5-15 mm)	11	24
	Large(More than 15 mm)	24	11
Cleft Palate type	soft palate (type2)	14	24
	junction hard/soft palate(type 3)	22	12
hospitalization	1 day	2	6
	2 days	23	22
	3 days	10	8
	4 days	1	0

As shown in Table 2, the relative frequency of lack of fistula is reported more than the occurrence of fistula in each group. In patients treated with Acellular Dermal Matrix, only in three cases (8.3%) and in control group six (16%) fistula formation was observed. there was no cases of infection in the surgical site in both study groups. No cases of wound dehiscence have been reported in all groups

Table 2
Frequency of occurrence of fistula, surgical site infection and the incidence of wound dehiscence in two groups of patients by type of surgical method

Surgery type	fistula formation		Incidence of surgical site infection		Incidence of wound dehiscence	
	Yes	No	Yes	No	Yes	No
Acellular Dermal Matrix	3	33	0	36	0	36
Other types except Acellular Dermal Matrix	6	30	0	36	0	36
Total	9	63	0	72	0	72
Chi-square statistical test	1.14					
P-value	0.285					

Discussion

The cleft palate is one of the most common craniofacial anomalies which requires a multidisciplinary treatment approach. Physiotherapy, nutrition, orthodontic management, and speech therapy can improve the quality of life of patients with cleft palate. Primary palatoplasty is usually recommended at early ages which ultimately leads to the return of the natural speech production mechanism. In palatoplasty, tension-free two-layer closure of oral cavities without penetration of water and fluids reduces the risk of the oronasal fistula. The repair will be effective when less tension is exerted on the oral layers (24). The success criteria of primary palatoplasty are the rate of oronasal fistula, Velopharyngeal insufficiency (VPI), and achievement of natural speech. In present study, we achieved the success criteria of the primary palatoplasty with intravelar veloplasty. Because the incidence of infection and wound dehiscence in each group was zero. In addition no fistula was reported in 63 of our patients after surgery.

Epidemiological studies of the cleft palate prevalence found that boys more than girls are likely to have this disorder (26). In the present study, fistula was observed in five boys and three girls' patients with a cleft greater than 15 mm.

Clark et al. in 2003 reported the use of ADM in primary palatoplasty. In a retrospective study, they investigated patients with a cleft palate greater than 15 mm who were candidates for palatoplasty and were subjected to two-flaps intravelar veloplasty using ADM. The result was completely successful in all patients. In two patients ADM was exposed but fistula was not formed (27). In our current study, out of 35 patients with a cleft palate greater than 15 mm who received ADM, twenty six had successful treatment.

In recent years, improvements have been made in the management of palatoplasty techniques and the timing to do a surgery leading to a decrease in the incidence of oronasal fistulas after primary palatoplasty. One of the studies that investigated the use of ADM in plastic surgeries was the 2012 retrospective case-series study by Aldekhayel et al. fistula incidence using ADM was estimated 7.1%. While recurrence of oronasal fistula using ADM was reported 11% (28). In our study recurrence of oronasal fistula was 8.3%.

When the use of ADM was first proposed for cleft palate surgery, successful results were observed in a small group of patients. A few years later, Kirschner in an empirical study in 2006 presented the results of using ADM to repair cleft palate fistulas. Four other studies assessed the applicability and utility of using ADM to prevent the occurrence of fistula in the primary palatoplasty (29).

Helling et al. described 32 surgeries for primary closure of cleft using the Furlow technique. In these surgeries, ADM was placed in junction between hard and soft palate. In 97% of cases the cleft was successfully closed. Only one of the patients had an oronasal fistula (30). Our therapeutic research team achieved similar results. The closure success rate was about 92%, and only three ADM recipient who had a cleft more than 15 mm in size and engagement of both soft and hard palate developed fistula after six months.

The largest collection of information about the use of ADM in the primary palatoplasty was published by Losee et al. in 2008. In order to close the cleft in these patients, Furlow palatoplasty with ADM and an algorithmic approach that would provide proper stable repair and also close the nasal cavity was used. The size of the cleft was not mentioned in this study; however, the closure of the cleft was achieved in 92.2% of the patients, and in only 4 (7.8%) cases, failure to close the cleft and occurrence of fistula was observed. The use of ADM in tenuous repair and the closure of the cleft and nasal defect resulted in satisfactory results (31). Although the evidence presented in this study confirms the results of our study, the differences in the type of palatoplasty technique in these two studies can be controversial.

Govshievich et al. in 2015 reported using ADM in the Furlow selective surgical procedure reduces fistula. In contrast, in a group of patients who were candidates for receiving ADM based on the size of the cleft (patients who had a cleft less than 15 mm had surgeries without ADM use) have more fistulas (32).

Aziz et al. in 2011 published the results of their study in which 3 patients were treated with intravelar veloplasty using ADM. This bond was placed between the muscle and the oral mucosa. The overall width of the cleft was 13.3 mm, and all patients improved without fistula formation (33). The success rate of cleft repair using ADM in our 12 patients with a cleft less than 15 mm was 100%. Our results are consistent with the aziz's study.

Gilardino et al. in 2018 in a prospective study conducted on 130 patients undergoing primary palatoplasty stated that the incidence of fistula in the study group using ADM was 1.5% versus 12.3% in the control group. The results of this study showed strong evidence of the positive effect of using ADM in the development of fistula following primary palatoplasty (25) .

Agir et al. in 2015, described the different methods of palatoplasty which were improved using ADM in 35 different patients. The average size of the cleft was 15 mm and in the subsequent examination 3 patients had fistulas. Although there was no strong evidence of routine use of ADM as primary palatoplasty; however, retrospective studies shows the advantage of using this method and other methods (26).

Hudson et al. in 2015, in a five year retrospective study assessed 6 patients who had a 10 mm cleft palate in average and had the primary palatoplasty with ADM. After one year of surgery, no fistula was seen in patients (34).

Winter et al. Performed 34 cleft reconstruction surgeries using ADM. Furlow palatoplasty was used for 5 patients and for other patients the intravelar veloplasty was used. Finally, the fistula formation was 6% (35).

Recommendations

Although the results of studies are not in favor of ADM, its use is increasing in recent years [35] the type and degree of the initial cleft palate seems to lead to the fistula reoccurrence. Since the results of this study showed a significant difference in the success of patients' treatment using ADM, it is suggested that further studies will be carried out in the future. In addition, because the incidence of the fistula has

been observed in patients with a cleft palate greater than 15 mm, this group of patients should be selected for future studies. If a similar type of surgical technique to previous studies is selected, the confounding factors of the study will be less and a better explanation for the results can be provided.

Declarations

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Authors' Contributions

H.A. conceived the main idea. M.H. and A.G. contributed in data gathering and analysis. SH.F, F.D and F.M. drafted the manuscript. H.A, A.G and SH.F revised the manuscript and acted as the guarantor of the manuscript. All authors read and approved the final manuscript.

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Availability of Data and Materials

SPSS data of the participant can be requested from the authors. Please write to the corresponding author if you are interested in such data.

Ethics Approval and Consent to Participate

Written informed consent was obtained from the patients in our study. The purpose of this research was completely explained to the patients, and they were assured that their information would be kept confidential by the researcher. Participants below the age of 16 were given written informed consent from parents/legal guardians. The ethical committee approved this research of Isfahan University of Medical Sciences. All procedures performed in studies were following the ethical standards of the Isfahan University of Medical Sciences.

Consent for Publication

Written informed consent was obtained from the patients regarding the publication of this study. For participants below the age 16 years old and written informed consent was given from parents/legal guardians.

Competing Interests

The authors declare that they have no competing interests.

References

1. Leow A-M, Lo L-J. Palatoplasty: evolution and controversies. *Chang Gung Med J.* 2008;31(4):335–45.
2. Markey J, Maine R, Daniels K, Yu EY, Gregory G, Hoffman W, et al. Otologic disease following palatoplasty in international cleft palate cohort. *The Cleft Palate-Craniofacial Journal.* 2018;55(2):162–7.
3. Smith DM, Losee JE. Cleft palate repair. *Clinics in plastic surgery.* 2014;41(2):189–210.
4. Nadjmi N. A Two-Stage Cleft Palate Repair. *Surgical Management of Cleft Lip and Palate: Springer;* 2018. p. 63–83.
5. Jayarajan R, Natarajan A, Nagamuttu R. Intravelar veloplasty: A review. *Journal of Cleft Lip Palate and Craniofacial Anomalies.* 2018;5(2):68.
6. Alonso N, Lima JE, de Andrade Lima HL, Jenny HE. Cleft Palate: Anatomy and Surgery. *Cleft Lip and Palate Treatment: Springer;* 2018. p. 139–54.
7. Hoghoughi MA, Kazemi T, Khojasteh A, Habibagahi R, Kalkate Z, Zarei Z, et al. The effect of intervalar veloplasty under magnification (Sommerlad’s Technique) without tympanostomy on middle ear effusion in cleft palate patients. *BMC pediatrics.* 2021;21(1):1–6.
8. Agrawal K. Cleft palate repair and variations. *Indian journal of plastic surgery: official publication of the Association of Plastic Surgeons of India.* 2009;42(Suppl):S102.
9. Katzel EB, Basile P, Koltz PF, Marcus JR, Giroto JA. Current surgical practices in cleft care: cleft palate repair techniques and postoperative care. *Plastic and reconstructive surgery.* 2009;124(3):899–906.
10. Losken HW, Van Aalst JA, Teotia SS, Dean SB, Hultman S, Uhrich KS. Achieving low cleft palate fistula rates: surgical results and techniques. *The Cleft Palate-Craniofacial Journal.* 2011;48(3):312–20.
11. de Ladeira PRS, Alonso N. Protocols in cleft lip and palate treatment: systematic review. *Plastic surgery international.* 2012;2012.
12. Sitzman TJ, Allori AC, Matic DB, Beals SP, Fisher DM, Samson TD, et al. Reliability of oronasal fistula classification. *The Cleft Palate-Craniofacial Journal.* 2018;55(6):871–5.
13. Yuan N, Dorafshar AH, Follmar KE, Pendleton C, Ferguson K, Redett III RJ. Effects of cleft width and veau type on incidence of palatal fistula and velopharyngeal insufficiency after cleft palate repair. *Annals of plastic surgery.* 2016;76(4):406–10.
14. Bykowski MR, Naran S, Winger DG, Losee JE. The rate of oronasal fistula following primary cleft palate surgery: a meta-analysis. *The Cleft Palate-Craniofacial Journal.* 2015;52(4):81–7.

15. Chin M, Ng T, Tom WK, Carstens M. Repair of alveolar clefts with recombinant human bone morphogenetic protein (rhBMP-2) in patients with clefts. *Journal of Craniofacial Surgery*. 2005;16(5):778–89.
16. Robertson AG, McKeown DJ, Bello-Rojas G, Chang Y-J, Rogers A, Beal BJ, et al. Use of buccal myomucosal flap in secondary cleft palate repair. *Plastic and reconstructive surgery*. 2008;122(3):910–7.
17. Levi B, Kasten SJ, Buchman SR. Utilization of the buccal fat pad flap for congenital cleft palate repair. *Plastic and reconstructive surgery*. 2009;123(3):1018–21.
18. Jackson IT, Moreira-Gonzalez AA, Rogers A, Beal BJ. The buccal flap—a useful technique in cleft palate repair? *The Cleft palate-craniofacial journal*. 2004;41(2):144–51.
19. Schliephake H. Clinical efficacy of growth factors to enhance tissue repair in oral and maxillofacial reconstruction: a systematic review. *Clinical implant dentistry and related research*. 2015;17(2):247–73.
20. Berna G, Cawthorn SJ, Papaccio G, Balestrieri N. Evaluation of a novel breast reconstruction technique using the Braxon® acellular dermal matrix: a new muscle-sparing breast reconstruction. *ANZ journal of surgery*. 2017;87(6):493–8.
21. Lee JH, Kim HG, Lee WJ. Characterization and tissue incorporation of cross-linked human acellular dermal matrix. *Biomaterials*. 2015;44:195–205.
22. Londono R, Badylak SF. Biologic scaffolds for regenerative medicine: mechanisms of in vivo remodeling. *Annals of biomedical engineering*. 2015;43(3):577–92.
23. Parmaksiz M, Dogan A, Odabas S, Elcin AE, Elcin YM. Clinical applications of decellularized extracellular matrices for tissue engineering and regenerative medicine. *Biomedical Materials*. 2016;11(2):022003.
24. Emodi O, Ginini JG, van Aalst JA, Shilo D, Naddaf R, Aizenbud D, et al. Cleft Palate Fistula Closure Utilizing Acellular Dermal Matrix. *Plastic and Reconstructive Surgery Global Open*. 2018;6(3).
25. Gilardino MS, Aldekhayel S, Govshievich A. A prospective study investigating fistula rate following primary palatoplasty using acellular dermal matrix. *Plastic and Reconstructive Surgery Global Open*. 2018;6(6).
26. Agir H, Eren GG, Yasar EK. Acellular dermal matrix use in cleft palate and palatal fistula repair: a potential benefit? *Journal of Craniofacial Surgery*. 2015;26(5):1517–22.
27. Clark JM, Saffold SH, Israel JM. Decellularized dermal grafting in cleft palate repair. *Archives of facial plastic surgery*. 2003;5(1):40–4.
28. Aldekhayel SA, Sinno H, Gilardino MS. Acellular dermal matrix in cleft palate repair: an evidence-based review. *Plastic and reconstructive surgery*. 2012;130(1):177–82.
29. Kirschner RE, Cabiling DS, Slemper AE, Siddiqi F, LaRossa DD, Losee JE. Repair of oronasal fistulae with acellular dermal matrices. *Plastic and reconstructive surgery*. 2006;118(6):1431–40.

30. Helling ER, Dev VR, Garza J, Barone C, Nelluri P, Wang PT. Low fistula rate in palatal clefts closed with the Furlow technique using decellularized dermis. *Plastic and reconstructive surgery*. 2006;117(7):2361–5.
31. Losee JE, Smith DM, Afifi AM, Jiang S, Ford M, Vecchione L, et al. A successful algorithm for limiting postoperative fistulae following palatal procedures in the patient with orofacial clefting. *Plastic and reconstructive surgery*. 2008;122(2):544–54.
32. Govshievich A, Aldekhayel S, Gilardino M. Acellular Dermal Matrix in Primary Palatoplasty: A Prospective Trial. *Plastic Surgery*. 2017;25(2):122-.
33. Aziz SR, Rhee ST, Ziccardi VB. Acellular dermal graft augmentation of primary palatoplasty: case report and review of the literature. *Journal of Oral and Maxillofacial Surgery*. 2011;69(4):1221–4.
34. Hudson JW, Pickett DO. A 5-year retrospective review of primary palatoplasty cases utilizing an acellular collagen interpositional graft. *Journal of Oral and Maxillofacial Surgery*. 2015;73(7):1393. e1- e3.
35. Winters R, Carter JM, Givens V, Hilaire HS. Persistent oro-nasal fistula after primary cleft palate repair: Minimizing the rate via a standardized protocol. *International journal of pediatric otorhinolaryngology*. 2014;78(1):132–4.

Figures



Figure 1

Using Acellular Dermal Matrix in palatal repair