

Public attitudes toward vascularized composite allograft donation: a literature review

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Abstract: Vascularized composite allotransplantation (VCA) is the transplantation of anatomical or functional structures composed of multiple types of tissues. The technical advancement of solid organ transplantation and replantation instigated the development of the skills required for successful VCA several years ago; however, the recent advancements in immunosuppression therapy have renewed the interest in this field. As VCAs are primarily life-enhancing procedures, the perception and attitudes of the general public (i.e. potential donors and candidates) and the health care professionals is extremely relevant in terms of health policy and funding decision allocations, availability of donor tissue and ethical and legal implications. In this article, we review the current evidence to assess the sociocultural and demographic factors that influence the growth and success of VCA procedures.

Keywords: allotransplantation, public attitudes, vascularized composite allograft, reconstruction, hand transplant, facial transplant

Background

Vascularized composite allotransplantation (VCA), also known as “reconstructive transplantation” or “composite tissue allotransplantation”, is the transplantation of heterogeneous tissues including skin, fat, bone, muscle, vessels, nerves and connective tissue as a single anatomical or functional unit (e.g. hand, leg, abdominal wall, face).^{1,2} To date, primary applications of VCA have been restricted to upper extremity and face transplants,^{3–7} although abdominal wall, lower extremity, scalp, larynx, uterus and penis transplantation have been reported in the literature.^{8–13} Unlike solid organ transplantations (SOTs), VCAs are not aimed to reduce mortality but to enhance the recipient’s quality of life by normalizing appearance and improving psychosocial function. Improvements in physical function may also be possible post-VCA which are typically not observed post-traditional reconstructive procedures, e.g. improved swallowing, breathing, talking or blinking post-facial VCA.¹⁴

The primary indications for VCA include defects due to trauma (e.g. automobile accidents or war-related), burns, infection and/or congenital anomalies, which are not amenable to traditional reconstructive procedures.¹⁵ VCAs are complex procedures with evolving techniques and procedures, and are associated with significant risks and potential challenges. Patients who undergo VCA face the lifelong burden of immunosuppression and its associated side-effects and complications, possible rejection (acute and chronic), psychological adjustment and need for prolonged rehabilitation.^{16,17} As such, the costs of VCA-associated interventions can be extensive. The growth of VCA procedures depends on the availability of skilled restorative plastic surgeon and

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surgical team, institutional support with required tangible and intangible resources and the viewpoints of medical community and general public on the benefit and risks of VCAs. To date, however, the literature on VCA has focused on technical aspects of VCA, immunosuppression therapy, rejection-related topics, ethical implications and psychological outcomes.¹⁸ Limited number of studies have focused on understanding the public's attitudes and knowledge toward VCA and its impact on health care policy and funding decisions and clinical care.¹⁸

In this article, we focus on the studies that examine the general public's (i.e. potential VCA candidates' – donors and recipients) knowledge and preferences regarding VCA and its impact on the success of VCA procedures. In the sections below, we review the factors that have been hypothesized to impact the attitudes of the general public on the VCA in the literature. A special note on the factors influencing surgeons, especially those working with pediatric population is included. This information will be useful to the allotransplant treatment team or the VCA candidates to understand their biases and/or to inform the pre-treatment consultation.

From donors' perspective

Public awareness

A study by Agbenorku et al¹⁹ found that a higher percentage of people are willing to accept a transplant than donate their faces after death. The strongest variables associated with the willingness to donate face after death include if the donor has an organ donor card, acceptance of plastic surgery if disfigured, acceptance of organ transplantation if needed, awareness of first facial transplant and being woman. Similarly, a survey study was conducted by Ozmen et al²⁰ in Turkish population and based on the results of 989 participants, the authors concluded that 79.5% of participants accepted to undergo facial allotransplantation but only 50.8% considered donating their faces. The participants were more accepting of transplantation with increased awareness of the procedure (i.e. numbers of facial VCA across the world) and when shown photos of severely disfigured faces.

The possibility of donating hands or face is not publicized like other organs (heart, kidney or liver). The disinclination of the general population to donate faces and extremities may be related to the desire to keep one's face or body intact. Hand and face are unique to the individual and perform complex and individualized tasks. Hence, the donation of these parts may be viewed by family or survivors as an

extension of donor's personality. Nonetheless, the physical integrity of the body is altered and may require special funeral arrangements to provide cosmetic prosthesis of similar skin tone and size for the individual.

Donation preferences tend strongly toward solid organs over hands and face. The main reason for reluctance to donate was the desire for one's face to remain intact after death and aversion toward another person looking like oneself, which is a representative of the central role of face in self-identity. This can be resolved with public education as the transplanted face is hybrid with appearance of donor's facial features and the recipient's underlying bone structure.

Confidentiality

Due to the innovative nature of VCA procedures, they garner substantial media attention and hype, raising several privacy and confidentiality concerns for the donor and donor's family which may impact attitudes toward donation. The likelihood of the donor's images and identity being released to the media should be discussed with the donor's family and that the privacy of donor cannot be guaranteed (e.g. facial recognition, fingerprints). Thorough informed consent and patient education should entail prior to harvesting donor tissues.²¹ In essence, the skill and training of the person obtaining the consent, the setting in which consent is requested and the attitude of the organ procurement team is of utmost importance in the possibility that the consent is obtained.

Sociodemographic factors

A survey study by Sarwer et al²² found that a higher percentage of people are willing to accept a facial transplant than donate after death. The variables that were strongly related to the willingness to donate face after death included being a woman, having an organ donor card, acceptance of plastic surgery if required, acceptance of organ transplant if needed and awareness of first facial transplant. The percentage of general public who were willing to donate their face was significantly low as compared to those who were willing to donate solid organs. Residents of Western countries (US, United Kingdom, France, Australia and Brazil) are generally more inclined to donate their faces after death. Younger people with higher level of education and those who have been recently disfigured were also found to show more enthusiasm about VCA.

Religious and cultural beliefs

The religious and sociocultural background of the donor and donor's caregivers strongly influence the motivation

and fears associated with allotransplantation. Knowledge of these beliefs also empowers the person obtaining the consent on how to best approach the donor families. An extensive review of the positions held by different religious groups concluded that most religions place no specific bans on allotransplantations (including hand and face).²³ In Christianity, donation is viewed as an act of charity and love by Catholics, Protestants, Baptists, Episcopalians and Lutherians. Similarly, in Islam, Judaism, Hinduism and Buddhism, transplantation of tissue and skin is considered noble and an act of altruism. However, Christianity and Islam prohibit transplantation of organs responsible for procreation (i.e. uterus, ovaries) and sexual pleasure (i.e. penis). In Far Eastern countries, preserving body integrity is considered crucial to better afterlife. Alongside, there are cultural superstitious regarding violating the dead, desire to be buried or cremated as whole, negative impact of donation on deceased family, rejection of the donor tissues and the belief that organ and tissue donation is against their religion. These factors significantly hinder the acceptance and growth of VCA procedures in countries practicing Chinese religions and Shinto (Japan).

It is interesting to note, however, that previous studies found that individuals who practiced Islam²⁰ and Roman Catholicism¹⁹ had a higher tendency of refusing facial donation than non-Islamic individuals and Christians of other sects, respectively. This highlights the influence of public awareness in influencing the acceptance of VCA donations.

Living donations

The benefit of living VCA donation to the donor is predominantly psychological. In the case of living donation of abdominal tissue for breast or post-traumatic reconstruction,²⁴ omentum for scalp reconstruction,²⁵ the donor's altruism also results in improved body image, appearance or function of the recipient.²⁶ However, special consideration must be given to risks of these procedures to the donor such as reduced sexuality (due to changes in body image), post-operative pain, reduced function (i.e. difficulties with daily activities, sleep and work) and psychological impact of the procedure, in addition to the complications associated with the surgery. As such, the living donations should only be discussed once all other conventional reconstructive options have been exhausted. The benefits of living VCA include optimal human leukocyte antigen matching (resulting in enhanced immune tolerance) and reduced ischemia times.²⁷ The living VCA donation is a relatively new area in restorative plastic

surgery and as such, the morbidity of the donated tissue should be thoroughly evaluated.²⁸ Guidance on development and implementation of policies and bylaws governing living VCA donations are outlined in the "Guidance Document" developed by the Organ Procurement and Transplantation Network/United Network for Organ Sharing (available at: <https://optn.transplant.hrsa.gov/resources/by-organ/vascular-composite-allograft/vcas-from-living-donors/>).

From recipients' perspective Assessment of risk/benefit ratio by candidates and recipients

Risk/benefit assessments are crucial to ethical and patient-centered decision-making in surgical/medical research. To balance risk and benefits of a treatment is a very complicated exercise. For most medications or interventions, the benefits are limited to a few indications and for an individual patient, there is usually only a single benefit sought, but the potential risks are multiple.²⁹ In case of VCA, a life-enhancing procedure as compared to SOT which is a life-saving procedure, there may be some risk associated with overestimating the benefits of VCA while minimizing the risks related to recovery period, surgical procedure, immunosuppression regime and ongoing rehabilitation.

In case of VCA, the perception of risks and benefits are closely aligned in the context in which they occur. For example, in the case of hand/arm transplantation, Majzoub et al³⁰ assessed the degree of risk that hand amputees (both below and above elbow) would be willing to accept using Louisville Instrument for Transplantation (LIFT). The authors concluded that the single hand/arm amputees were significantly risk averse when compared to double hand/arm amputees. One plausible explanation maybe that the patients have learnt to effectively function with one functioning hand and/or effective prosthesis. For these patients, the risks of lifelong immunosuppression therapy and potential rejection of the transplantation significantly outweighed the benefit of the procedure. On the other hand, for double amputee patients, the hand allotransplantation may offer improved function (motor and sensory) and hence, they were found to be accepting of the allotransplantation. Similarly, when the health preferences of hand amputee patients was evaluated using preference-elicitation techniques (i.e. standard gamble and time-trade off), the participants did not show a preference toward VCA due to the risks associated with the procedure and immunosuppression.³¹

Facially disfigured individuals who could benefit from face transplant view the risks of immunosuppression and rejection to be far less than the benefit.^{32–34} These individuals perceive the choice of not having the transplant as equivalent to their willing acceptance of a terrible loss, namely the loss of normal facial appearance and of quality of life that such as normal life afforded. Further, traditional facial reconstruction in a multi-stage procedure as compared to facial transplant which is typically achieved in one procedure. Research has shown that patients with facial transplant show an initial decline in health-related quality of life and psychosocial functioning (i.e. identity confusion, depersonalization about transplanted face), followed by improved psychosocial outcomes such as low rates of depression, verbal abuse, improved body image and appearance and societal integration.^{34–41}

Previous studies demonstrate that real-life exposure to immunosuppression (such as in kidney transplant patients) does not alter the perception of the recipients toward their transplant. This indicates that recipients are pragmatic when weighing the risks and benefits of immunosuppression and rejection prior to VCA.⁴²

Cost of procedure/reimbursement

VCA procedures are complex and often involve a series of operations using a rotating team of surgeons and other specialists with procedures lasting 8–15 hrs. As such, the costs of the VCA procedure and the aftercare can be substantial. As VCA is life-enhancing procedure, the general population's opinion is that the costs should be the responsibility of the recipient (i.e. paid out-of-pocket) than by insurance plans (public or private or hybrid).²² This is especially true when the disfiguring accident is caused by the recipients' own actions. On the contrary, payment for VCAs for disfigured military personnel and not-at-fault accident victims through insurance policies is supported.²²

The reimbursement policies (public or private health care system) are regulated based on the country or the region like other health care interventions. For example, in Austria, the cost of the VCA procedures and aftercare is covered by the insurance plan of the recipient; however, in Belgium, the cost of the first face transplant was raised by the transplant hospital.⁴³ In the UK, the National Health Services covered the cost of up to 4 recipients per year under the public insurance plan. In any case, the high lifetime cost associated with VCA should be justified against using other cost-effective methods such as bionic arms or robotic prosthesis.⁴³

In addition to VCA-related costs, the recipient and their caregivers often have several indirect out-of-pocket costs such as travel to treatment center, accommodation, productivity loss and caregiver costs. These costs are far beyond the means of most potential VCA candidates and hence, they often resort to fundraising or loans. The high cost associated with VCA not only prevents a lot of people from accessing it, but it also hinders the advancement of restorative plastic surgery as a speciality.²²

Ethical considerations

As the field of VCA is elementary, proceeding with VCA in clinical practice and research has several ethical implications. As the regulatory guidance^{15,17,44,45} on patient selection, qualifications of the surgical team, management of transplant failure and patient dissatisfaction is mostly derived from solid organ transplant literature; there is an urgent need to focus on factors that are unique to VCA. To elaborate, the patient–provider relationships in VCA are distinct and challenging as surgeons, patient, family and caregivers spend extensive time with each other due to the complexity and long-term risks of the procedure. This may result in unhealthy attention or prioritizing of the patient or patient having an unrealistic expectation of the provider.⁴⁶ This is reinforced by the media attention that many VCA patients are quick to receive. This may interfere with informed consent as patients may feel obligated to go through the procedure due to the fear of disappointing their surgeon or health care team. From the surgeon's perspective, there may be (unethical) inherent biases in selecting the recipient for the VCA as patients who have less psychological issues, better social support or are able to afford long-term post-operative therapy, and as such have higher chances of successful outcome and favorable press coverage.⁴⁶ Standardization of surgeon-reported and patient-reported outcome data to be collected pre- and post-operatively on expectations and health-related quality of life outcomes is an important step to prevent such biases, in addition to increasing public awareness of such procedures.

From surgeon's perspective

The attitude of surgeon toward VCA has been explored in case of hand and face transplantation. In a survey of hand surgeons, Mathes et al (2009)⁴⁷ found that 24% of the hand surgeons were in favor of transplantation, 45% were against and 31% were undecided. The main indications for hand transplantation that were endorsed by the

hand surgeons included bilateral amputation of hands, amputation of dominant hand and multiple failed reconstructions (e.g. failed toe to thumb). Similarly, a survey of burns and plastic surgeons⁴⁸ concluded that facial transplantation should be reserved for more severe cases, where traditional facial reconstructive options have been exhausted. The most acceptable indications for facial transplantation were multiple failed reconstructions, total facial burn, absence of remote or local tissue for reconstructions and loss of lip and nose.

In a study comparing five different groups, i.e. facially disfigured individuals, reconstructive surgeons, organ transplant recipients, professionals who manage immunosuppression medication and health volunteers, the reconstructive surgeons were found to be the least tolerant of the risks concerning facial allotransplantation.⁴⁹ This is important because as primary caregivers, the surgeons must be mindful of the risks associated with chronic immunosuppression (e.g. infections, increased risk of malignancy, possible organ failure or metabolic disorders), potential tissue rejection, cost associated with pre-, intra- and post-operative regimes and patient adherence (to immunotherapy and rehabilitation). In a qualitative study by Prior and Klein (2011)⁵⁰ of medical health professionals, apart from the concerns listed above, the ethics of transplantation and a thorough assessment of the psychological state of the patient and patient's ability to cope with the outcome of transplantation were also raised by professionals. Schrott et al⁵¹ hypothesized that physicians are also strongly influenced by their training of doing no harm and the inherent personal burden of an unfavorable outcome.

VCA are high-risk procedures and for the majority remain experimental with little to no evidence on the intermediate to long-term outcomes. As such, the attitude of the surgeon spans from that of prudence to dismissal.

Special note: pediatric patients

Due to the newness of the VCA in pediatric patients, the evidence regarding public attitudes on the topic is slim. However, it is reasonable to hypothesize that pediatric patients (16 years or younger) may not be able to completely understand the short- or long-term commitments, risks and complications (i.e. tissue rejection) of the VCA procedure. As children are still developing their personal and psychological identity, they may experience depersonalization or identity confusion with their newly transplanted body part. This may result in significant psychosocial impairment related to school (bullying,

verbal or physical abuse, relationship building issues with teachers or peers) and family life (feeling or looking different than siblings or family members).^{52,53}

From the donor perspective, the donor's family may view the transplanted body part (e.g. face) as a means of continuing their child's life and hence may expect to relate to the recipient. The recipient or their caregivers may have body image and appearance or function-related expectations from the procedure which may or may not be fulfilled post-surgery.⁵⁴ Irrespective of the outcome of pediatric VCA, careful consideration must be given to the significant burden of hospitalization, procedure, immunosuppression, adverse effects of medications, compliance with medications and rehabilitation and finances on both the pediatric patient and caregivers.

Discussion

VCA is an emerging albeit promising field of treatment for devastating bodily injuries, especially facial and upper extremity defects. Nevertheless, it also results in considerable burden and risks on the VCA recipient. The mid- to long-term survival of the allograft is undetermined and the VCA procedure itself does not extend or preserve life; rather, it improves the quality of life of the recipient. The attitudes of the surgeon and treatment team, caregivers and potential candidates have been explored to some extent in the literature. An understanding of the perceptions and attitudes of the general public with regard to VCA is an important topic as it provides elementary information regarding the awareness of VCA, potential for future increase in number of allograft donors and also assists in identifying the relevant ethical, legal, health policy and funding implications of the public attitudes on growth and success of the VCA procedures.¹⁸

The technical expertise (i.e. microsurgery, vascular and nerve anastomoses and immunological reaction) developed in the field of SOT, limb and face replantation laid the foundations for the development of the VCA procedures. However, evidence shows that there is a significant discrepancy in the attitudes of general public toward SOT and VCA. The SOTs, being life-saving procedures, are generally better accepted in the society as compared to VCA. For instance, Sarwer et al²² found that the public is supportive of the funding through insurance (public or private) for SOT; however, for VCA, the consensus is that it should be funded by the recipient out-of-pocket. This hinders the growth and uptake of VCA as a plastic surgery speciality.

Potential VCA recipients do not have any life-threatening conditions. Therefore, their motivation is related to improved body image, satisfaction with appearance, psychosocial

outcomes, integration into societal roles (caregiver, work) and functional outcomes.³³ The visible nature of the allograft, as compared to SOT, significantly impacts the lived experience of VCA for recipients. It interferes with the recipient's perception of self and coping with the loss of their body part. This, combined with the immediate post-operative reduction in psychosocial well-being, life-long immunosuppression therapy and rehabilitation and risks of rejection and complication, results in VCA being a resource-intensive treatment.³³ However, for patients with severe disfigurement or functional loss, it may be the only option.

Evidence shows that people who are younger, from Western countries, have higher education and have heard of previous successful allotransplantations are more likely to endorse VCA.¹⁸ Subsequently, there is scope to increase awareness in general public on the benefit(s) of VCA for the recipient and impact on donor or donor's family. The educational campaigns designed to increase awareness of VCA should not be included alongside solid organ donation so as to not interfere with life-saving donations. The health care professionals specializing in VCAs should advocate for better, stringent policies around creating priority-based waitlists for VCA (keeping in mind the cosmetic-related issues of VCA, i.e. skin color, tone, etc.), ethics and legal implications of VCA. More research is needed to understand the long-term body image and psychological implications of VCAs, parallel to guidelines to thoroughly assess the psychiatric, coping and social support of the recipient prior to VCA. There is an urgent need for patient-reported outcome measures to assess the health-related quality of life impact of loss of body part (i.e. face, upper extremity) and the impact of VCA and chronic therapy (immunosuppression and rehabilitation). More advanced techniques such as donor pre-conditioning should be investigated. Donor pre-condition development of recipient-specific chimerism in donor allograft by infusion of recipient's bone marrow cells prior to transplantation (i.e. reverse chimerism induction). If effective, the donor pre-conditioning has the potential to reduce or eliminate the negative effects of life-long immunosuppression therapies, and hence, increasing the acceptance of VCA.⁵⁵

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References

- Siemionow MZ, Kulahci Y, Bozkurt M. Composite tissue allotransplantation. *Plast Reconstr Surg.* 2009;124(6S):e327–e339. doi:10.1097/PRS.0b013e3181bf8413
- Mendenhall SD, Ginnetti MT, Sawyer JD, et al. Prevalence and distribution of potential vascularized composite allotransplant donors, implications for optimizing the donor-recipient match. *Plast Reconstr Surg Glob Open.* 2018;6(6). doi:10.1097/GOX.0000000000001833
- Shores JT, Brandacher G, Lee WA. Hand and upper extremity transplantation: an update of outcomes in the worldwide experience. *Plast Reconstr Surg.* 2015;135(2):351e–360e. doi:10.1097/PRS.0000000000001024
- Petruzzo P, Lanzetta M, Dubernard J-M, et al. The international registry on hand and composite tissue transplantation. *Transplantation.* 2010;90(12):1590–1594. doi:10.1097/TP.0b013e3181ff1472
- Dubernard J-M, Lengelé B, Morelon E, et al. Outcomes 18 months after the first human partial face transplantation. *N Engl J Med.* 2007;357(24):2451–2460. doi:10.1056/NEJMoa072828
- Sosin M, Rodriguez ED. The face transplantation update: 2016. *Plast Reconstr Surg.* 2016;137(6):1841–1850. doi:10.1097/PRS.0000000000002149
- Khalifian S, Brazio PS, Mohan R, et al. Facial transplantation: the first 9 years. *Lancet.* 2014;384(9960):2153–2163. doi:10.1016/S0140-6736(13)62632-X
- Giele H, Vaidya A, Reddy S, Vrakas G, Friend P. Current state of abdominal wall transplantation. *Curr Opin Organ Transplant.* 2016;21(2):159–164. doi:10.1097/MOT.0000000000000276
- Cavadas P, Thione A, Carballeira A, Blanes M. Bilateral transfemoral lower extremity transplantation: result at 1 year. *Am J Transplant.* 2013;13(5):1343–1349. doi:10.1111/ajt.12178
- Krishnan G, Du C, Fishman JM, et al. The current status of human laryngeal transplantation in 2017: a state of the field review. *Laryngoscope.* 2017;127(8):1861–1868. doi:10.1002/lary.26503
- Ozkan O, Akar ME, Ozkan O, et al. Preliminary results of the first human uterus transplantation from a multiorgan donor. *Fertil Steril.* 2013;99(2):470–476. e5. doi:10.1016/j.fertnstert.2012.09.009
- van der Merwe A, Graewe F, Zühlke A, et al. Penile allotransplantation for penis amputation following ritual circumcision: a case report with 24 months of follow-up. *Lancet.* 2017;390(10099):1038–1047. doi:10.1016/S0140-6736(17)31807-X
- Sosin M, Ceradini DJ, Levine JP, et al. Total face, eyelids, ears, scalp, and skeletal subunit transplant: a reconstructive solution for the full face and total scalp burn. *Plast Reconstr Surg.* 2016;138(1):205–219. doi:10.1097/PRS.0000000000002322
- Cavadas PC, Ibáñez J, Thione A. Surgical aspects of a lower face, mandible, and tongue allotransplantation. *J Reconstr Microsurg.* 2012;28(01):43–48. doi:10.1055/s-0031-1284236
- Cendales L, Granger D, Henry M, et al. Implementation of vascularized composite allografts in the United States: recommendations from the ASTS VCA Ad Hoc committee and the executive committee. *Am J Transplant.* 2011;11(1):13–17. doi:10.1111/j.1600-6143.2010.03374.x
- Murphy BD, Zuker RM, Borschel GH. Vascularized composite allotransplantation: an update on medical and surgical progress and remaining challenges. *J Plast Reconstr Aesthetic Surg.* 2013;66(11):1449–1455. doi:10.1016/j.bjps.2013.06.037
- Cherikh WS, Cendales LC, Wholley CL, et al. Vascularized composite allotransplantation in the United States: a descriptive analysis of the organ procurement and transplantation network data. *Am J Transplant.* 2019;19(3):865–875. doi:10.1111/ajt.15062

18. Denadai R, Araujo KC, Pinho AS, Denadai R, Araujo GH, Raposo-Amaral CE. Public's knowledge and attitudes toward vascularized composite allotransplantation and donation. *Aesthetic Plast Surg.* 2016;40(2):301–308. doi:10.1007/s00266-016-0623-z
19. Agbenorku P, Agbenorku M, Agamah G. Awareness and attitudes towards face and organ transplant in Kumasi, Ghana. *Ghana Med J.* 2013;47(1):30–34.
20. Ozmen S, Findikcioglu F, Sezgin B, Findikcioglu K, Kucuker I, Atabay K. Would you be a face transplant donor? A survey of the Turkish population about face allotransplantation. *Ann Plast Surg.* 2013;71(2):233–237. doi:10.1097/SAP.0b013e31826cadd2
21. Agich GJ, Siemionow M. Until they have faces: the ethics of facial allograft transplantation. *J Med Ethics.* 2005;31(12):707–709. doi:10.1136/jme.2005.011841
22. Sarwer DB, Ritter S, Reiser K, et al. Attitudes toward vascularized composite allotransplantation of the hands and face in an urban population. *Vascularized Compos Allotransplant.* 2014;1(1–2):22–30. doi:10.4161/23723505.2014.975021
23. Siemionow MZ, Rampazzo A, Gharb BB. Addressing religious and cultural differences in views on transplantation, including composite tissue allotransplantation. *Ann Plast Surg.* 2011;66(4):410–415. doi:10.1097/SAP.0b013e3182121db9
24. Allen RJ Jr, LoTempio MM, Craigie JE, Allen RJ Sr. Transplantation in identical twins: another option for breast reconstruction. *Plast Reconstr Surg.* 2008;122(4):1019–1023. doi:10.1097/PRS.0b013e3181858bb6
25. Buncke HJ, Hoffman WY, Alpert BS, Gordon L, Stefani AE. Microvascular transplant of two free scalp flaps between identical twins. *Plast Reconstr Surg.* 1982;70(5):605. doi:10.1097/00006534-198211000-00015
26. Pomahac B, Alhefzi M, Bueno EM, McDiarmid SV, Levin LS. Living donation of vascularized composite allografts. *Plast Reconstr Surg.* 2018;142(3):405e–411e. doi:10.1097/PRS.0000000000004659
27. Cecka JM. The OPTN/UNOS renal transplant registry 2003. *Clin Transpl.* 2003;1–12.
28. Grant DW, Grant DW, Mlodinow A, Ver Halen JP, Kim J. Catastrophic outcomes in free tissue transfer: a six-year review of the NSQIP database. *Plast Surg Int.* 2014;2014.
29. Edwards IR, Wiholm B-E, Martinez C. Concepts in risk-benefit assessment. *Drug Saf.* 1996;15(1):1–7. doi:10.2165/00002018-199615010-00001
30. Majzoub RK, Cunningham M, Grossi F, Maldonado C, Banis JC, Barker JH. Investigation of risk acceptance in hand transplantation. *J Hand Surg Am.* 2006;31(2):295–302. doi:10.1016/j.jhsa.2005.09.013
31. Alolabi N, Chuback J, Grad S, Thoma A. The utility of hand transplantation in hand amputee patients. *J Hand Surg Am.* 2015;40(1):8–14. doi:10.1016/j.jhsa.2014.08.048
32. Barker JH, Furr A, Cunningham M, et al. Investigation of risk acceptance in facial transplantation. *Plast Reconstr Surg.* 2006;118(3):663–670. doi:10.1097/01.prs.0000233202.98336.8c
33. Cugno S, Sprague S, Duku E, Thoma A. Composite tissue allotransplantation of the face: decision analysis model. *Can J Plast Surg.* 2007;15(3):145–152. doi:10.1177/229255030701500304
34. Chuback J, Yarascavitch B, Yarascavitch A, Kaur MN, Martin S, Thoma A. Measuring utilities of severe facial disfigurement and composite tissue allotransplantation of the face in patients with severe face and neck burns from the perspectives of the general public, medical experts and patients. *Burns.* 2015;41(7):1524–1531. doi:10.1016/j.burns.2015.05.002
35. Kumnig M, Jowsey-Gregoire SG. Key psychosocial challenges in vascularized composite allotransplantation. *World J Transplant.* 2016;6(1):91. doi:10.5500/wjt.v6.i1.91
36. Coffman KL, Siemionow MZ. Face transplantation: psychological outcomes at three-year follow-up. *Psychosomatics.* 2013;54(4):372–378. doi:10.1016/j.psym.2012.10.009
37. Chang G, Pomahac B. Psychosocial changes 6 months after face transplantation. *Psychosomatics.* 2013;54(4):367–371. doi:10.1016/j.psym.2012.07.012
38. Coffman KL, Gordon C, Siemionow M. Psychological outcomes with face transplantation: overview and case report. *Curr Opin Organ Transplant.* 2010;15(2):236–240. doi:10.1097/MOT.0b013e328337267d
39. Lemmens GM, Poppe C, Hendrickx H, et al. Facial transplantation in a blind patient: psychologic, marital, and family outcomes at 15 months follow-up. *Psychosomatics.* 2015;56(4):362–370. doi:10.1016/j.psym.2014.05.002
40. Barret JP, Gavaldà J, Bueno J, et al. Full face transplant: the first case report. *Ann Surg.* 2011;254(2):252–256. doi:10.1097/SLA.0b013e318226a607
41. Singhal D, Pribaz JJ, Pomahac B. The Brigham and women's hospital face transplant program: a look back. *Plast Reconstr Surg.* 2012;129(1):81e–88e. doi:10.1097/PRS.0b013e31823621db
42. Brouha P, Naidu D, Cunningham M, et al. Risk acceptance in composite-tissue allotransplantation reconstructive procedures. *Microsurgery.* 2006;26(3):144–149. doi:10.1002/(ISSN)1098-2752
43. Samuel U. Regulatory aspects of VCA in eurotransplant. *Transplant Int.* 2016;29(6):686–693. doi:10.1111/tri.12753
44. Tintle SM, Potter BK, Elliott RM, Levin LS. Hand transplantation. *JBJS Rev.* 2014;2:1. doi:10.2106/JBJS.RVW.M.00063
45. Siemionow M, Gordon C. Overview of guidelines for establishing a face transplant program: a work in progress. *Am J Transplant.* 2010;10(5):1290–1296. doi:10.1111/j.1600-6143.2010.03096.x
46. Caplan AL, Parent B, Kahn J, et al. Emerging ethical challenges raised by the evolution of vascularized composite allotransplantation. *Transplantation.* 2019;103(6):1240–1246. doi:10.1097/TP.0000000000002478
47. Mathes DW, Schlenker R, Ploplys E, Vedder N. A survey of North American hand surgeons on their current attitudes toward hand transplantation. *J Hand Surg Am.* 2009;34(5):808–814. e2. doi:10.1016/j.jhsa.2009.01.021
48. Mathes DW, Kumar N, Ploplys E. A survey of North American burn and plastic surgeons on their current attitudes toward facial transplantation. *J Am Coll Surg.* 2009;208(6):1051–1058. e3. doi:10.1016/j.jamcollsurg.2009.01.051
49. Vasilic D, Reynolds CC, Cunningham M, et al. Plastic surgeon's risk acceptance in facial transplantation. *Plast Reconstr Surg.* 2008;121(3):41e–48e. doi:10.1097/01.prs.0000299303.64919.11
50. Prior JJ, Klein O. A qualitative analysis of attitudes to face transplants: contrasting views of the general public and medical professionals. *Psychol Health.* 2011;26(12):1589–1605. doi:10.1080/08870446.2010.545888
51. Schroth WS, Riegelman RK, Blacklow BG. Medical students' risk-taking behavior in "patient" versus "physician" decision frames: implications for medical education. *Acad Med.* 1994. doi:10.1097/00001888-199410000-00041
52. Stam H, Hartman EE, Deurloo JA, Groothoff J, Grootenhuys MA. Young adult patients with a history of pediatric disease: impact on course of life and transition into adulthood. *J Adolesc Health.* 2006;39(1):4–13. doi:10.1016/j.jadohealth.2005.03.011
53. Lorot-Marchand A, Guerreschi P, Pellerin P, et al. Frequency and socio-psychological impact of taunting in school-age patients with cleft lip-palate surgical repair. *Int J Pediatr Otorhinolaryngol.* 2015;79(7):1041–1048. doi:10.1016/j.ijporl.2015.04.024
54. Benghiac AG, Garrett JR, Carter BS. Ethical issues in pediatric face transplantation. *Pediatr Transplant.* 2017;21(7):e13032. doi:10.1111/ptr.13032
55. Siemionow M, Rampazzo A, Gharb BB, et al. The reversed paradigm of chimerism induction: donor conditioning with recipient-derived bone marrow cells as a novel approach for tolerance induction in vascularized composite allotransplantation. *Microsurgery.* 2016;36(8):676–683. doi:10.1002/micr.30041

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