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Influence of using a single facial vein as outflow in full-face transplantation: A three-dimensional computed tomographic study

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Summary *Background:* The aim of this study was to evaluate the contribution of a single unilateral facial vein in the venous outflow of total-face allograft using three-dimensional computed tomographic imaging techniques to further elucidate the mechanisms of venous complications following total-face transplant.
Methods: Full-face soft-tissue flaps were harvested from fresh adult human cadavers. A single facial vein was identified and injected distally to the submandibular gland with a radiopaque contrast (barium sulfate/gelatin mixture) in every specimen. Following vascular injections, three-dimensional computed tomographic venographies of the faces were performed. Images were viewed using TeraRecon Software (Teracon, Inc., San Mateo, CA, USA) allowing analysis of the venous anatomy and perfusion in different facial subunits by observing radiopaque filling venous patterns.
Results: Three-dimensional computed tomographic venographies demonstrated a venous network with different degrees of perfusion in subunits of the face in relation to the facial vein injection side: 100% of ipsilateral and contralateral forehead units, 100% of ipsilateral and 75% of contralateral periorbital units, 100% of ipsilateral and 25% of contralateral cheek units, 100% of ipsilateral and 75% of contralateral nose units, 100% of ipsilateral and 75% of contralateral upper lip units, 100% of ipsilateral and 25% of contralateral lower lip units, and 50% of ipsilateral and 25% of contralateral chin units.
Conclusion: Venographies of the full-face grafts revealed better perfusion in the ipsilateral hemifaces from the facial vein in comparison with the contralateral hemifaces. Reduced

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perfusion was observed mostly in the contralateral cheek unit and contralateral lower face including the lower lip and chin units.

Introduction

Facial allotransplantation allows the restoration of form and function for the most complex facial defects that is not achievable with conventional reconstructive procedures using autologous tissue transfer. Since the first face transplant was performed in 2005 in France,[1] the field has expanded significantly, and since then >30 patients have received a face transplant in different centers in the world.[2–5]

With the development of the field of vascular composite allotransplantation (VCA), there is a need to increase the safety of the procedure by decreasing the risk of complications both perioperatively and in the long term by adequate surgical planning.[5] From a surgical perspective, face transplantation combines both craniofacial and microsurgical reconstruction techniques, and as with any other free flap, it entails a risk of vascular complications leading to vessel thrombosis. This risk, by extrapolation to the experience in autologous free tissue transfer, could be expected to happen between 5% and 10% of the cases,[6–8] and therefore it can be a major contributor in partial or total facial flap loss. At the present moment, the majority of the full-face transplants has been performed by microsurgical connection of bilateral pedicles in the face; however, it has been suggested by experimental studies that the full facial flap can be adequately perfused from a single pedicle.[6] The use of bilateral pedicles with at least two arteries and two veins has been recommended in face transplantation by most authors[7]; thus, bilateral pedicles are used as a safety net to ensure total perfusion to the face.

Of the 27 cases of face transplantation reported up to 2013,[4,5] vascular complications were reported in only two cases in the immediate postoperative period. Both were associated with venous thrombosis, which was successfully solved in both cases.[9,10] This is congruent with the majority of the vascular complications in conventional free tissue transfer in head and neck reconstruction where venous problems are more commonly seen than arterial occlusion.[11] In face transplantation, for the most part, the venous drainage has relied on a number of veins including the facial, retromandibular, internal, and external jugular veins performing multiple anastomoses. Therefore, it is difficult to establish the relative importance of every single vein in the total perfusion of the face and thereby predicting the more sensitive areas for venous congestion in the face, potentially leading to partial flap loss. The facial vein has been used as the main outflow in most facial transplants; however, it is unclear whether a single facial vein would be sufficient to perfuse the total facial flap and which part of the facial flap may be more sensitive to partial flap necrosis. In a case of traumatic face amputation and replantation where a single facial vein was used, it has been noted that the contralateral face suffered venous congestion, and contralateral venous anastomoses were necessary to relieve venous insufficiency.[12]

This study was conducted to investigate the contribution of a single facial vein in the perfusion of total-face transplant by using three-dimensional computed tomographic venography in an anatomical study in human faces.

Materials and methods

Five fresh human adult cadavers were studied, four males and one female with a mean age of 75.6 years. The cadavers were acquired through the Willed Body Program at the University of Texas Southwestern Medical Center.

Full-face flaps were harvested in all specimens. A single facial vein was identified, cannulated, and injected with a radiopaque contrast, and three-dimensional computed tomographic venographies were performed.

Surgical protocol: full-face harvesting technique

A full-face flap was harvested including only soft tissues. A bicoronal incision was positioned a few centimeters behind the hairline, and it was elongated caudally with a preauricular incision to the cervical region. After the elevation of a platysma myocutaneous flap in the neck, the external jugular vein along with the facial and retromandibular veins was dissected out and referenced. The veins were dissected distally extending to the parotid and submandibular glands. The external carotid and facial artery were identified and referenced, and the anterior belly of the digastrics and the hypoglossal nerve were divided to provide better exposure. Then, from the cranial to caudal direction, the scalp was harvested in a subgaleal plane and in the subperiosteal plane 2 cm above the orbital rim. The supraorbital and supratrochlear nerves and arteries were divided, and the subperiosteal dissection in the nose and in the lateral orbital rims was performed. The medial and lateral cantal ligaments were identified, both of which were divided. From the preauricular area, the flaps were harvested including the parotid gland from the inferior and posterior lobe of the gland and separation from the sternocleidomastoideus muscle. The posterior belly of the digastric muscle was identified, and the facial nerve was transected at its exit from the stylomastoid foramen. The deep temporal vessels and the internal maxillary vessels were ligated, and the flap was harvested from the lateral to the