Hand and arm transplants

Clinical Policy ID: CCP.1321

Recent review date: 9/2025

Next review date: 1/2027

Policy contains: Composite tissue allotransplantation; forearm transplant; hand transplant.

FirstChoice VIP Care has developed clinical policies to assist with making coverage determinations. FirstChoice VIP Care's clinical policies are based on guidelines from established industry sources, such as the Centers for Medicare & Medicaid Services (CMS), state regulatory agencies, the American Medical Association (AMA), medical specialty professional societies, and peer-reviewed professional literature. These clinical policies along with other sources, such as plan benefits and state and federal laws and regulatory requirements, including any state- or plan-specific definition of "medically necessary," and the specific facts of the particular situation are considered, on a case by case basis, by FirstChoice VIP Care when making coverage determinations. In the event of conflict between this clinical policy and plan benefits and/or state or federal laws and/or regulatory requirements, the plan benefits and/or state and federal laws and/or regulatory requirements shall control. FirstChoice VIP Care's clinical policies are for informational purposes only and not intended as medical advice or to direct treatment. Physicians and other health care providers are solely responsible for the treatment decisions for their patients. FirstChoice VIP Care's clinical policies are reflective of evidence-based medicine at the time of review. As medical science evolves, FirstChoice VIP Care will update its clinical policies as necessary. FirstChoice VIP Care's clinical policies are not guarantees of payment.

Coverage policy

Hand and arm transplants are investigational/not clinically proven and, therefore, not medically necessary.

Limitations

All other uses of hand and arm transplants are not medically necessary.

Alternative covered services

- Limb replantation.
- Upper limb prosthesis.
- Physical and occupational therapy.

Background

In the United States, approximately 2.1 million people live with limb loss, a number expected to double by 2050 (Access Prosthetics, 2017). Upper-limb amputations make up a minority – between one fifth and one sixth – of total amputations. Seventy percent of upper-limb amputations are below the elbow, with 10% of these at the hand or wrist (Fahrenkopf, 2018).

Composite tissue allotransplantation is the transfer of vascularized or non-vascularized heterogeneous tissues with different antigenicities from one person to another. Unlike a solid organ transplant, vascularized composite tissue allotransplantation involves multiple tissues (e.g., skin, muscle, tendon, bone, cartilage, fat, nerves, and

blood vessels). Composite tissue allotransplantation is a complex procedure requiring multidisciplinary technical skills and understanding of its immunologic aspects. It is a treatment for complex injuries that leave patients with structural, functional, and aesthetic deficits that cannot be addressed by other means (American Society of Transplantation, 2015).

Hand and arm transplantations are forms of vascularized composite tissue allotransplantation. Hand transplantation is an extremely complex procedure that can last from eight to ten hours; following the procedure, transplant recipients require life-long immunosuppressive therapy and intensive physical therapy to regain hand and arm function (The Johns Hopkins University, 2024).

The first hand transplant was attempted in 1964 in South America without success. In the United States, advances in surgical technique and immunosuppression allowed for the first successful hand transplant in 1999. Vascularized composite tissue allotransplantation is regulated, as are all solid organ transplants, within the Organ Procurement and Transplantation Network (80 FR 26464). Since 1998, 18 unilateral and 19 bilateral upper limb transplants have been performed in the United States (Organ Procurement and Transplantation Network, 2024).

Findings

The evidence on upper extremity transplantation consistently highlights an uncertain risk-benefit profile, a conclusion informing a cautious approach across all evidence types. Clinical guidelines, particularly from health technology assessment bodies, question the procedure's value due to uncertain long-term benefits and high costs (Health Quality Ontario, 2016; National Institute for Health and Care Excellence, 2011). This stance is supported by systematic reviews that, while noting potential functional gains (Wells, 2022), quantitatively detail significant risks, including high rates of acute rejection and severe complications from lifelong immunosuppression (Huelsboemer, 2024b; Milek, 2023). Other evidence from clinical reports and comparative studies further underscores this caution, establishing stringent patient selection criteria (Mendenhall, 2020) and situating the procedure as one of several options, including advanced prosthetics (Efanov, 2022).

Guidelines:

Official guidelines from major professional and health technology assessment bodies frame hand transplantation as a specialized therapeutic option rather than a standard procedure, citing an uncertain balance of benefits and risks. This is exemplified by Health Quality Ontario, which recommends against publicly funding the procedure due to both uncertain clinical benefit and poor value for money (Health Quality Ontario, 2016). Similarly, the National Institute for Health and Care Excellence (NICE) states that current evidence on the efficacy and safety of the procedure is "inadequate in quantity," while the American Society for Surgery of the Hand (ASSH) and the Transplantation Society of Australia and New Zealand (TSANZ) both emphasize that it is a quality-of-life procedure that may introduce life-shortening risks from lifelong immunosuppression (American Society for Surgery of the Hand, 2013; Dwyer, 2019; National Institute for Health and Care Excellence, 2011). Consequently, guidelines impose stringent patient selection criteria; for example, the TSANZ endorses the procedure only for bilateral amputees and encourages a trial with prosthetics first, a more restrictive approach than in other jurisdictions (Dwyer, 2019). Ultimately, all guidance documents mandate that the procedure be performed exclusively in specialized centers with multidisciplinary teams experienced in both hand surgery and transplant medicine, and under special arrangements for clinical governance, consent, and ongoing research to address the current evidence gaps (American Society for Surgery of the Hand, 2013; Health Quality Ontario, 2016; National Institute for Health and Care Excellence, 2011).

Systematic Reviews

Complications and Immunosuppression

Systematic reviews report that acute rejection affects a majority of recipients, with rates ranging from 65.9% in a hand transplant-only cohort to over 90% in a cohort of mixed transplant types (Huelsboemer, 2024b; Milek, 2023). A broader analysis across 211 vascularized composite allograft cases found an average of 1.45 acute rejections per patient, with higher rates in burn patients than trauma patients (3.73 vs 1.78 average rejections) (Van Dieren, 2024). These events contribute to the risk of graft failure, with one review reporting graft loss in 13.2% of hand transplant patients and another citing allograft removal in 22% of its cohort (Huelsboemer, 2024b; Milek, 2023).

These complications are managed with intensive immunosuppressive regimens that carry their own significant risks. The common protocol, used in over 90% of hand transplant patients, involves induction therapy followed by triple maintenance therapy with tacrolimus, mycophenolate mofetil, and steroids (Huelsboemer, 2024b; Van Dieren, 2024). This long-term therapy is associated with high rates of opportunistic infections, impaired glucose metabolism (62%), and renal insufficiency (26%) (Milek, 2023). This has led some authors to conclude that the side effects of immunosuppression "remain difficult to reconcile" with the benefits of a procedure that is not life-saving (Huelsboemer, 2024b).

To better manage these risks, research has focused on identifying biomarkers of rejection. A systematic review that analyzed data from 22 articles, encompassing a total of 26 patients, investigated this issue. The review found that donor specific antibodies were significantly associated with higher rejection grades (mean grades of 2.7 versus 2.2, P=0.005). The authors noted, however, that the utility of their findings was limited by inconsistent reporting between centers and the absence of standardized diagnostic guidelines for antibody-mediated rejection (Huelsboemer, 2024a).

Functional Outcomes and Patient Selection

Evidence from systematic reviews suggests that functional improvements are achievable, though the certainty of these findings is limited. One review of 108 studies showed that disability scores of the arm, shoulder, and hand declined (indicating improvement) significantly following transplantation (Wells, 2022). However, the literature is characterized by a lack of standardized assessment tools and significant heterogeneity in outcome measures, making direct comparison across studies difficult. Achieving positive outcomes is also linked to patient selection; a review of practices at transplantation centers identified the patient's capacity to manage the allograft post-transplantation—including access to follow-up and psychological stability—as a key criterion (Laspro, 2023).

Other Evidence

Patient selection criteria are further detailed in reports based on clinical experience. These sources frequently cite an age range of 18 to 69 years, an absence of significant medical or psychosocial issues, and no recent history of cancer as important factors for candidacy (MacKey, 2014; Mendenhall, 2020). A qualitative study of 50 candidates and recipients confirmed that patient preferences for candidacy were similar to these established criteria (Vanterpool, 2023). An important consideration in this selection process is the comparison to alternatives; a comparative study of 26 hand transplants and 45 myoelectric prostheses found no significant difference in overall quality-adjusted life-years (P=.36), but did find significantly higher quality-adjusted life-years for prostheses in the subgroup of unilateral amputees (P=.0015) (Efanov, 2022).

In 2025, the findings were revised thematically and included previously uncited guidelines (American Society for Surgery of the Hand, 2013; Dwyer, 2019) and recent systematic reviews (Huelsboemer, 2024a, 2024b; Van Dieren, 2024). No policy changes were warranted.

References

On July 30, 2025, we searched PubMed and the databases of the Cochrane Library, the U.K. National Health Services Centre for Reviews and Dissemination, the Agency for Healthcare Research and Quality, and the Centers for Medicare & Medicaid Services. Search terms were “Vascularized Composite Allotransplantation” (MeSH), “Transplantation, Homologous" (MeSH), “Upper Extremity” (MeSH), “Composite Tissue Allografts” (MeSH), “arm transplant,” and “hand transplant.” We included the best available evidence according to established evidence hierarchies (typically systematic reviews, meta-analyses, and full economic analyses, where available) and professional guidelines based on such evidence and clinical expertise.

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Policy updates

7/2017: initial review date and clinical policy effective date: 8/2017

9/2018: Policy references updated. Policy ID changed.

9/2019: Policy references updated.

9/2020: Policy references updated.

9/2021: Policy references updated.

9/2022: Policy references updated.

9/2023: Policy references updated.

9/2024: Policy references updated.

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