

A clinical case

Autotransplantation of the Metatarsophalangeal Joint of the Foot to the Hand for Posttraumatic Ankylosis of the Metacarpophalangeal Joint: A Case Report

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Abstract

Posttraumatic bony ankylosis of the metacarpophalangeal (MCP) joint of the hand is a severe and disabling consequence of trauma, as it completely eliminates finger motion and markedly limits grip function. Arthrodesis provides stability at the cost of joint mobility, while arthroplasty carries a risk of instability and implant wear, making the search for biological reconstruction methods clinically relevant.

The purpose of this manuscript is to present a clinical case of reconstruction of the MCP joint of the hand by free microsurgical autotransplantation of the second metatarsophalangeal joint of the foot in a patient with posttraumatic bony ankylosis.

A 42-year-old patient with ankylosis of the MCP joint of the right ring finger, one year after trauma, underwent free microsurgical transfer of the second metatarsophalangeal joint of the right foot with vascular and nerve reconstruction; the donor defect of the foot was reconstructed with a bone graft.

The early postoperative period was uneventful. At 4 months, radiographic union of the graft was confirmed. At 9 months, active motion in the transplanted joint had recovered, by goniometric assessment, to approximately 95% of the range of motion of the unaffected joint; grip function was sufficient for daily and occupational activities, and the donor site of the foot showed no functional deficit.

Conclusions. In the presented case, free microsurgical autotransplantation of the metatarsophalangeal joint of the foot restored mobility and grip function of the hand without significant complications at the donor site. The method may be considered one option for biological reconstruction of MCP joints in selected patients; further studies with larger case series are needed to evaluate its effectiveness.

Keywords: ankylosis, metacarpophalangeal joint, microsurgery, autotransplantation, hand reconstructive surgery, vascularized joint graft.

1. Introduction

Injuries of the metacarpophalangeal (MCP) joints of the hand remain one of the most challenging problems in hand reconstructive surgery: these joints provide precision and power grip, coordinate finger movements, and largely determine the overall

functional capacity of the hand. Posttraumatic bony ankylosis of the MCP joint, in which complete fusion of the articular surfaces occurs with loss of the joint space, is among the most severe and disabling consequences

of hand trauma, as it precludes both fine and power movements of the finger [1,2].

Surgical strategy for MCP joint ankylosis remains a subject of debate. Arthrodesis provides stability but completely eliminates joint motion. Arthroplasty with pyrocarbon or silicone implants preserves mobility but is associated with a substantial reoperation rate: according to recent case series and national arthroplasty registries, the mid-term revision rate after MCP joint arthroplasty reaches 10–20% [3–5]. The advent of individualized 3D-printed implants is regarded as a promising direction for treating posttraumatic joint defects, although clinical experience with their use remains limited [6].

An alternative approach is biological joint reconstruction using a free vascularized osteoarticular

autograft, most often a toe joint. Such a graft allows simultaneous replacement of the articular surfaces, capsuloligamentous apparatus, and soft-tissue envelope as a single viable composite [7]. Systematic reviews of case series of free microsurgical toe joint transfer report high graft survival (over 95%), but a lower range of motion compared with arthroplasty and a rate of significant complications reaching 25–30% [8,9].

The aim of this report is to present a clinical case of successful reconstruction of the MCP joint of the hand by free microsurgical autotransplantation of the second metatarsophalangeal joint of the foot for posttraumatic ankylosis.

2. Clinical Case Description

Patient D., 42 years old, presented with complaints of absent motion in the right ring finger, decreased grip strength, and inability to perform fine hand manipulations. History revealed that approximately one year earlier the patient had sustained an injury to the right hand involving the MCP joint of the ring finger; treatment at the prehospital stage was conservative. Over the following months, joint motion progressively declined, resulting in a persistent bony block with deformity and functional insufficiency of the finger.

On examination: the skin over the joint was unremarkable, palpation was painless, and a firm, immobile joint block was noted; active and passive motion were completely absent. Radiography confirmed bony ankylosis of the MCP joint of the ring finger — complete fusion of the articular surfaces with obliteration of the joint space (Figure 1). For donor-site planning, targeted radiography of the foot was performed to assess the second metatarsophalangeal joint (Figure 2).



Figure 1 - Preoperative radiograph of the hand (dorsopalmar view): bony ankylosis of the MCP joint of the ring finger — complete fusion of the articular surfaces with obliteration of the joint space

Given the marked and persistent functional insufficiency of the finger, the exhaustion of conservative treatment options, and the patient's young working age, the decision was made to proceed with reconstructive surgery — free microsurgical transfer of the second metatarsophalangeal joint of the right foot to the hand.

Alternative options — arthrodesis and arthroplasty — were considered and rejected: arthrodesis would not restore joint motion, while arthroplasty in the setting of pre-existing ankylosis carries an increased risk of instability of the scarred periarticular soft-tissue envelope.



Figure 2 - Preoperative radiograph of the foot (dorsoplantar view): assessment of the donor second metatarsophalangeal joint before graft harvest

The surgical plan was discussed in detail with the patient, and written informed consent was obtained for both the procedure and publication of the clinical case.

Surgical technique. The procedure was performed in three stages by a single surgical team under combined anesthesia (brachial plexus block and spinal anesthesia). In the first stage, the ankylosed MCP joint was approached through an S-shaped dorsal incision over the finger; a bone segment approximately 1.5 cm long was resected on both sides of the joint, preserving the volar plate, joint capsule, and lumbrical tendons; under the operating microscope, the proper palmar digital artery and nerve were identified and marked. In the second stage, following preoperative marking of the vascular pedicle course on the dorsum of the donor foot (Figure 3a), a tissue complex comprising the metatarsophalangeal joint, approximately 1.5 cm long, was harvested through a curvilinear incision on the lateral aspect of the second toe, including the joint,

branches of the proper digital artery, accompanying nerve branches, and a segment of the flexor tendon (Figure 3b); the donor defect of the foot was reconstructed with a bone fragment removed from the hand, fixed with a 0.88-mm Kirschner wire. In the third stage, the joint graft was adapted to the size of the hand defect and fixed with four crossed Kirschner wires under intraoperative fluoroscopic control (Figure 3c); the capsuloligamentous apparatus and tendons were reconstructed; under the microscope, an arterial anastomosis (11-0 suture) and a venous anastomosis were performed, and the nerve was repaired end-to-side (10-0 suture). After tourniquet release, adequate perfusion of the graft was noted, confirming patency of the vascular anastomoses. Operative time was 2.5 hours, blood loss approximately 100 mL; no intraoperative complications occurred, and the patient was transferred to the ward in stable condition.



Figure 3 – Surgical stages: (a) preoperative marking of the vascular pedicle course on the dorsum of the donor foot; (b) intraoperative view of the hand wound after excision of the ankylosed joint and isolation of the neurovascular pedicle; (c) intraoperative fluoroscopy of the hand after fixation of the joint graft with Kirschner wires

Postoperative course. The wound healed by primary intention with no signs of inflammation; mild residual edema was resolved with physiotherapy and lymphatic drainage massage. Rehabilitation followed a standard protocol, including therapeutic exercise, passive joint mobilization, physiotherapy, and electrical stimulation of the hand muscles.

At 4 months, radiography confirmed good consolidation of the graft's bony structures with preservation of the joint space, without signs of resorption or wire migration (Figure 4, Figure 5); passive range of motion at this stage reached 30–40°.



Figure 4 - Radiograph of the hand at 4 months postoperatively (dorsopalmar view): graft consolidation, preserved joint space, Kirschner wire fixation



Figure 5 - Radiograph of the hand at 4 months postoperatively (oblique view)



Figure 6 - Active finger extension at 9 months postoperatively



Figure 7 - Active fist closure at 9 months postoperatively — assessment of power grip function



Figure 8 – Palmar view of the hand at 9 months postoperatively: finger abduction

At 9 months postoperatively, active range of motion in the transplanted joint had reached, by goniometric assessment, approximately 95% of the range of motion of the unaffected MCP joint; grip function was restored to a degree sufficient for fine and power movements, as well as daily and occupational activities, without significant limitations (Figures 6–10).

Cutaneous sensation over the graft was partially restored, with adequate protective sensibility; the cosmetic result was satisfactory. The donor site of the foot healed without complications, weight-bearing capacity and gait were unaffected, there was no pain, and the cosmetic defect was minimal (Figure 11).



Figure 9 – Dorsal view of the hand at 9 months postoperatively



Figure 10 - Finger flexion into a fist (close-up) at 9 months postoperatively



Figure 11 – Appearance of the donor foot site at 9 months postoperatively: healed surgical scar, cosmetic result

Standardized hand-function scales (e.g., QuickDASH) and foot-function scales were not used in this observation — functional outcome was assessed

clinically and goniometrically, which limits direct comparison with published case series and is noted below as a limitation of the study.

4. Discussion

The presented observation demonstrates restoration of mobility and grip function of the MCP joint of the hand in a patient with posttraumatic bony ankylosis by means of free microsurgical autotransplantation of the metatarsophalangeal joint of the foot: graft consolidation was achieved, active range of motion at 9 months approached that of the unaffected joint, and no complications occurred at the donor site.

The choice of reconstructive method for MCP joint ankylosis remains debated. Arthroplasty with pyrocarbon or silicone implants has shown consistently good results in recent years in terms of range of motion and pain relief, but is associated with a substantial reoperation rate: according to case series and national registries, the mid-term revision rate reaches 10–20% [3–5]. This is compounded in patients with pre-existing ankylosis, since marked scarring of the capsuloligamentous apparatus increases the risk of implant instability, a finding also reported in series of arthroplasty for ankylosed interphalangeal joints [1,2].

The free vascularized osteoarticular autograft used in the present case allows simultaneous replacement of the articular surfaces, capsuloligamentous apparatus, tendons, and soft-tissue envelope as a single viable

composite, which is particularly valuable in combined bone and soft-tissue defects [7]. At the same time, systematic reviews of case series of free toe joint transfer report high graft survival (over 95%), but on average a lower range of motion compared with arthroplasty and a rate of significant complications reaching 25–30%, including extensor lag, stiffness, and partial sensory loss [8,9]. In the present observation, the achieved range of active motion exceeded the average figures of such series, which may be related to preservation of the periarticular soft tissues of the hand at the time of surgery, the absence of a prior infectious component, and the patient's young age — factors also associated in the literature with a more favorable prognosis [9].

A limitation of this observation is the use of clinical and radiographic assessment alone, without standardized hand-function scales, as well as the relatively short follow-up period (9 months), which is insufficient to judge long-term graft stability or possible cartilage resorption. Furthermore, the analysis is limited to a single clinical observation, which in itself does not allow generalizable conclusions about the effectiveness of the method and warrants caution when extrapolating the result to a broader patient population.

5. Conclusions

In the presented clinical case, free microsurgical autotransplantation of the metatarsophalangeal joint of the foot eliminated posttraumatic bony ankylosis of the MCP joint of the hand, restoring finger mobility and grip function without significant complications at either the donor or recipient site over a 9-month follow-up period.

This result demonstrates the technical feasibility and potential clinical benefit of this approach in an individual patient but cannot be regarded as proof of the method's overall effectiveness. Further studies with larger case series, longer follow-up, and standardized hand-function scales are needed to assess the reproducibility of the result, the long-term stability of the graft, and the place of this method among other options for reconstruction of the metacarpophalangeal joints.

Ethical aspects. This work represents a description of a single clinical case within routine clinical practice and did not require separate approval from a local ethics committee. Written informed consent was obtained from the patient for the surgical procedure and for publication of the clinical data, radiographs, and photographic material.

Conflict of interest. The authors declare no conflict of interest.

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All authors have read and approved the final version of the manuscript and take responsibility for all aspects of the work.

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Саусақ-алақан буынының жарақаттан кейінгі анкилозы кезінде аяқтың табан-бақай буынын қолға аутоотрансплантациялау: Клиникалық жағдайды сипаттау

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Түйіндеме

Қолдың қолбасы-саусақ (ҚС) буынының жарақаттан кейінгі сүйекті анкилозы мүгедектікке әкелетін ауыр жарақат салдары болып табылады. Себебі анкилоз саусақ қозғалысын толығымен шектейді және қолдың қармау қызметін айтарлықтай төмендетеді. Артродез буын қозғалғыштығын жоғалту есебінен тұрақтылықты қамтамасыз етеді, ал артропластика тұрақсыздық пен импланттың тозу қаупімен байланысты, бұл биологиялық реконструкция әдістерін іздеудің клиникалық өзектілігін арттырады.

Жұмыстың мақсаты: жарақаттан кейінгі сүйекті анкилозы бар науқаста аяқ басының екінші табан-фаланга буынын еркін микрохирургиялық аутоотрансплантациялау әдісімен қолдың ҚС буынын қалпына келтірудің клиникалық жағдайын ұсыну.

Оң қолдың аты жоқ саусағының ҚС буыны анкилозы бар 42 жастағы науқасқа (жарақаттан кейін бір жыл өткен соң) тамырлар мен жүйкелерді қалпына келтіре отырып, оң аяқ басының екінші табан-фаланга буынын еркін микрохирургиялық ауыстырып қондыру отасы жасалды. Аяқтағы донорлық аймақтың сүйек ақауы сүйек трансплантатымен толтырылды. Отадан кейінгі ерте кезең асқынусыз өтті. 4 айдан кейін трансплантаттың рентгенологиялық бітісуі расталды. 9 айдан кейін ауыстырып қондырылған буынның белсенді қозғалғыштығы (гониометрия мәліметтері бойынша) интактілі буынның қозғалыс амплитудасының шамамен 95%-на дейін қалпына келді. Қармау қызметі күнделікті және кәсіби міндеттерді орындау үшін жеткілікті болды, ал аяқтың донорлық аймағында функционалдық тапшылық байқалмады.

Қорытынды. Ұсынылған жағдайда аяқ басының табан-фаланга буынын еркін микрохирургиялық аутоотрансплантациялау донорлық аймақта елеулі асқынуларсыз қолбасының қозғалғыштығы мен қармау функциясын қалпына келтіруге мүмкіндік берді. Аталмыш әдісті іріктелген науқастарда ҚС буындарын биологиялық реконструкциялаудың нұсқаларының бірі ретінде қарастыруға болады. Оның тиімділігін бағалау үшін бұдан да үлкен бақылау серияларын талдайтын алдағы зерттеулер қажет.

Түйін сөздер: анкилоз, қолбасы-фаланга буыны, микрохирургия, аутоотрансплантация, қолбасының реконструктивті хирургиясы, васкуляризацияланған буын трансплантаты.

Аутоотрансплантация плюснефалангового сустава стопы на кисть при посттравматическом анкилозе пястно-фалангового сустава: Описание клинического случая

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Резюме

Посттравматический костный анкилоз пястно-фалангового (ПФ) сустава кисти является тяжелым последствием травмы, приводящим к инвалидизации, поскольку он полностью исключает движения пальца и существенно ограничивает функцию захвата. Артродез обеспечивает стабильность ценой утраты подвижности сустава, тогда как артропластика сопряжена с риском нестабильности и износа имплантата, что делает поиск методов биологической реконструкции клинически актуальным.

Цель данной работы: представить клинический случай реконструкции ПФ сустава кисти методом свободной микрохирургической аутоотрансплантации второго плюснефалангового сустава стопы у пациента с посттравматическим костным анкилозом.

42-летнему пациенту с анкилозом ПФ сустава безымянного пальца правой кисти (через год после травмы) была выполнена свободная микрохирургическая пересадка второго плюснефалангового сустава правой стопы с восстановлением сосудов и нервов; дефект кости в донорской зоне стопы был замещен костным трансплантатом. Ранний послеоперационный период протекал без осложнений. Через 4 месяца было подтверждено рентгенологическое сращение трансплантата. Через 9 месяцев активная подвижность в пересаженном суставе восстановилась (по данным гониометрии) примерно до 95% от амплитуды движений в интактном суставе; функция захвата была достаточной для выполнения повседневных и профессиональных задач, а в донорской зоне стопы функционального дефицита не наблюдалось.

Выводы. В представленном случае свободная микрохирургическая аутоотрансплантация плюснефалангового сустава стопы позволила восстановить подвижность и функцию захвата кисти без значимых осложнений в донорской зоне. Данный метод может рассматриваться как один из вариантов биологической реконструкции ПФ-суставов у отобранных пациентов. Для оценки его эффективности необходимы дальнейшие исследования с анализом более крупных серий наблюдений.

Ключевые слова: анкилоз, пястно-фаланговый сустав, микрохирургия, аутоотрансплантация, реконструктивная хирургия кисти, васкуляризированный суставной трансплантат.