

The Use of Stromal Vascular Fraction, Platelet-rich Plasma, and Stem Cells in the Treatment of Thumb Carpometacarpal Osteoarthritis

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Background: Thumb function is integral to hand movement and overall hand function. Impairment, often caused by carpometacarpal (CMC) arthritis, reduces the quality of life. Here, we explored a novel approach using a mixture of the stromal vascular fraction, adipose-derived stem cells, and platelet-rich plasma to treat symptomatic trapeziometacarpal osteoarthritis.

Methods: Retrospective data from 30 hands of 19 patients classified as Eaton and Littler stages 1–4 were analyzed. Platelet-rich plasma and fat were collected under sterile conditions, followed by centrifugation, stem cell extraction, and injection of the mixture into the thumb CMC joint under x-ray guidance. The measurement parameters included the visual analog scale pain score, grip strength, pinch strength, and Thumb Disability Examination (TDX) score. Statistical analysis was performed using paired *t* tests to evaluate the outcomes across the entire group, individual stages, and early/late stages.

Results: We examined 30 hands of 19 patients with trapeziometacarpal osteoarthritis. Pain reduction was significant at 6 and 24 months for all stages, particularly stages 2 and 3. Substantial pain reduction was also observed at the early and late stages. The TDX score decreased significantly in all groups after 6 and 24 months. Hand function notably improved with significant gains in tip-to-tip pinch strength at 24 months and palmar pinch strength at 6 and 24 months. No complications were observed.

Conclusions: The intra-articular injection of autologous conditioned plasma/stromal vascular fraction in patients with thumb CMC arthritis, in all stages, helps to improve pain symptoms and postpone potential resection arthroplasty with minimal surgical intervention and risks. (*Plast Reconstr Surg Glob Open* 2025;13:e6481; doi: [10.1097/GOX.00000000000006481](https://doi.org/10.1097/GOX.00000000000006481); Published online 27 February 2025.)

INTRODUCTION

The thumb plays a crucial role in hand function, accounting for approximately half of all hand movements,^{1,2} and provides opposition ability. Impairment of thumb function can greatly affect the overall hand

function. This impairment is usually caused by carpometacarpal (CMC) arthritis of the thumb, resulting from ligament instability, hormonal influences, congenital angles, or trauma.^{2–5}

CMC arthritis of the thumb is relatively common, with prevalence rates ranging from 7% to 17% in men and 15% to 27% in women.^{2,6–8} Patients with CMC arthritis of the thumb often experience more severe pain and functional limitations than those with other types of hand arthritis, leading to a reduced quality of life.^{2,9,10}

Various therapeutic approaches are available for treatment. In the early stages, conservative methods, such as oral pain medication and topical diclofenac gel, are typically recommended to alleviate pain with fewer systemic side effects.^{2,11} Physical therapy and splint immobilization also reduce pain and improve thumb function.^{2,12–14} Infiltration therapy using corticosteroids or hyaluronic acid is another viable option to consider before opting for

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surgical treatment. These infiltrations significantly reduce pain and enhance thumb function.^{2,15,16}

Recently, autologous substances, such as platelet-rich plasma (PRP) and autologous fat grafting, have gained attention as therapeutic options. PRP, a plasma fraction with high platelet concentrations, contains growth factors that promote wound healing, tissue regeneration, and hyaluronic acid synthesis.^{2,17–23} Fat transfer acts as a mechanical spacer, provides immunomodulatory and chondroprotective effects, and contains mesenchymal stem cells that can differentiate into various tissue types, including chondrocytes.^{2,24–27}

The infiltration of autologous substances into the CMC joint of the thumb has shown promising results in reducing pain and improving joint arthrosis. Some studies even suggest that autologous substances may be more effective in reducing pain than steroid infiltrations.^{2,28} Winter et al²⁹ demonstrated considerable improvement in pain reduction, hand function, and quality of life with autologous substances compared with 0.9% saline.

Furthermore, in a comparison of autologous conditioned serum, bone marrow aspirate concentrate, botulinum toxin, corticosteroids, hyaluronic acid, mesenchymal stem cells, ozone, saline placebo, PRP, plasma rich in growth factor, and stromal vascular fraction (SVF) in knee osteoarthritis, SVF showed the greatest improvement in pain reduction and functional outcomes for up to 1 year of follow-up.³⁰

As a modification of these recently described techniques, we developed a mixture of SVF, adipose-derived stem cells, and PRP. In this study, we aimed to determine the outcomes of pain reduction, hand function, and quality of life in patients with symptomatic trapeziometacarpal osteoarthritis who were treated using this new technique.

PATIENTS AND METHODS

Study Population

This study was approved by the ethics board of the Salzburg State Council, Austria. The retrospective data analysis was conducted between September 2019 and September 2020. All patients who underwent intra-articular infiltration with autologous conditioned plasma (ACP)/SVF for symptomatic trapeziometacarpal osteoarthritis classified according to the Eaton and Littler stages 1–4 were included. The exclusion criteria were previous joint surgery and age younger than 18 years. Nineteen patients were included in this study, and 30 hands underwent treatment (Table 1). The mean age was 60.6 years. The measurement data were collected before surgery and at 6 and 24 months postoperatively, with a mean follow-up period of 2 years. One milliliter of ACP/SVF was injected into the thumb

Table 1. Demographic Data

Descriptive	Statistics	Count	Mean
Sex	Female	27	
	Male	3	
Age			60.6
Affected	Right	12	
Side	Left	18	

Takeaways

Question: Platelet-rich plasma/stromal vascular fraction injection into the thumb carpometacarpal joint significantly relieves pain in carpometacarpal osteoarthritis.

Findings: We analyzed 30 hands from 19 patients with trapeziometacarpal osteoarthritis. Pain reduction was significant at 6 and 24 months, especially in stages 2 and 3. The TDX score and hand function improved notably, with increased pinch strength observed at 6 and 24 months. No complications occurred.

Meaning: Intra-articular injection of autologous conditioned plasma/stromal vascular fraction in early-stage carpometacarpal arthritis reduces pain and may delay the need for resection arthroplasty with minimal surgical risks.

CMC joints of all patients. During the study period, no secondary injections took place.

The hands were grouped according to the classification by Eaton and Littler based on preoperative radiographs. Statistical analysis of each stage was conducted after Eaton and Littler classification into early (Eaton/Littler stages 1–2) and late (Eaton/Littler stages 3–4) stages.

Surgical Technique

All interventions were performed under general anesthesia. Subsequently, 15 mL of blood was collected under sterile conditions in a double-syringe system and centrifuged at 1500 rpm for 5 minutes to generate PRP. Next, 15 mL of fat was collected from the abdominal wall using a double-syringe system and centrifuged at 2500 rpm for 5 minutes. After removing the oily and watery phases, the fat cells were crushed through a 1.4 mm transfer device to remove the adipose tissue stem cells. Another centrifugation cycle was performed using a double-syringe device.

Stem cells were extracted and mixed with the collected PRP. Using a blunt infiltration needle, 1 mL of the mixture was injected into the thumb CMC joint under x-ray guidance.

Measurement Parameters

Measurements were obtained preoperatively and at 6 and 24 months postoperatively. The main measurement parameter was pain, which was examined during the first consultation and follow-up appointments using the visual analog scale score. Furthermore, during all consultations, grip strength was measured using a dynamometer. The pinch strength (lateral pinch, palmar pinch, and tip-to-tip pinch) was measured using a pinch meter. The Thumb Disability Examination (TDX) score, a tool for measuring quality of life in patients with basal joint arthritis, was examined during all consultations. Complications were recorded during follow-up.

Statistical Analysis

Statistical analysis for all participants and each group and the early (Eaton/Littler stages 1–2) and late (Eaton/Littler stages 3–4) stages were performed using paired *t* tests.

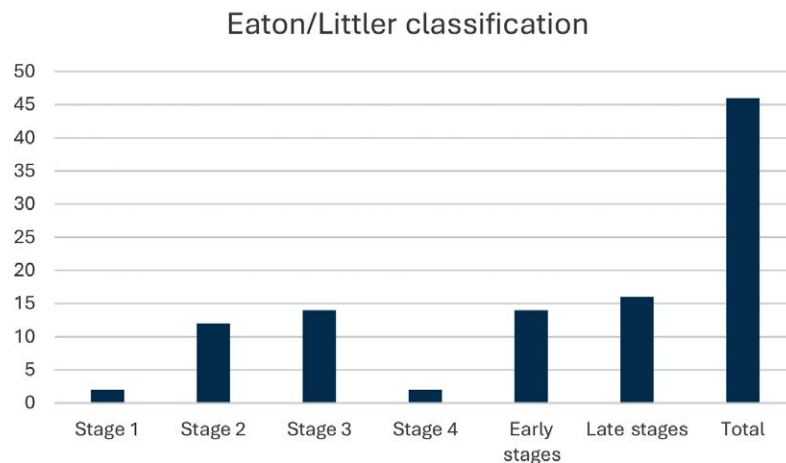


Fig. 1. A bar chart that shows the distribution of groups according to the Eaton/Littler classification: stage 1, 2 hands; stage 2, 12 hands; stage 3, 14 hands; stage 4, 2 hands; early stages, 14 hands; late stages, 16 hands; and total, 30 hands.

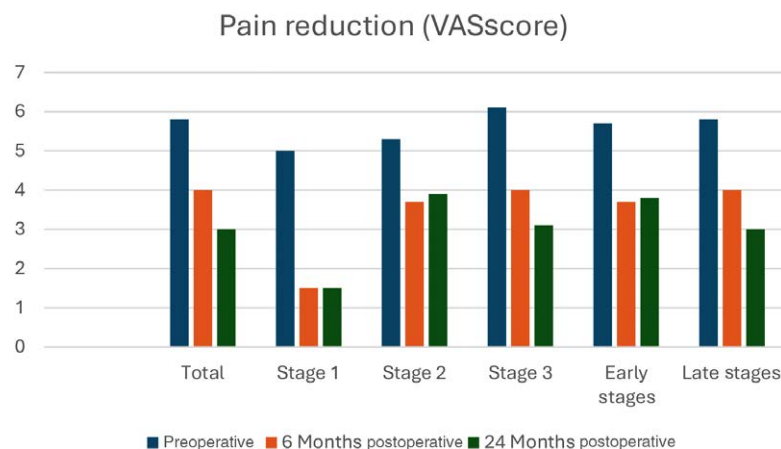


Fig. 2. A bar chart that shows the results of the pain reduction.

Descriptive data were presented as arithmetic means. All statistical analyses were performed using IBM SPSS version 24.0.

RESULTS

Thirty hands from 19 patients were included in this study (Fig. 1). The study included 2 hands with stage 1, 12 hands with stage 2, 14 hands with stage 3, and 2 hands with stage 4. A total of 14 hands were included in the early-stage group (stage 1 – 2 according to Eaton/Littler), and 16 hands were included in the late-stage group (stage 3 – 4 according to Eaton/Littler). The Eaton/Littler early- and late-stage classifications are shown in Figure 2. The analysis was performed for the entire study population and the participants in the early- and late-stage groups. Treatment of 1 hand with stage 4 was converted to a resection arthroplasty after 4 months.

Pain Reduction

During follow-up, significant pain reduction was observed after 6 ($P = 0.015$) and 24 months ($P < 0.001$) in the total study population. In patients with stage 2 osteoarthritis, significant pain reduction was observed at both

time points (6 months, $P < 0.001$; 24 months, $P = 0.010$). In patients with stage 3 osteoarthritis, significant pain reduction was observed after 24 months ($P = 0.001$). In addition, significant pain reduction was observed after 6 ($P < 0.001$) and 24 months ($P = 0.009$) in the early-stage group and after 24 months ($P < 0.001$) in the late-stage group (Table 2; Fig. 2).

TDX Score

The TDX score decreased in all groups at both measurement time points. For the entire study population, significant reductions were observed after 6 ($P < 0.001$) and 24 months ($P = 0.050$). For stages 2 ($P = 0.002$) and 3 ($P < 0.001$), significant reductions were observed after 6 months. Furthermore, a significant decrease in the TDX score was observed for the early stages after 6 months ($P < 0.001$) and the late stages after 6 ($P < 0.001$) and 24 months ($P = 0.041$) (Table 3; Fig. 3).

Hand Function

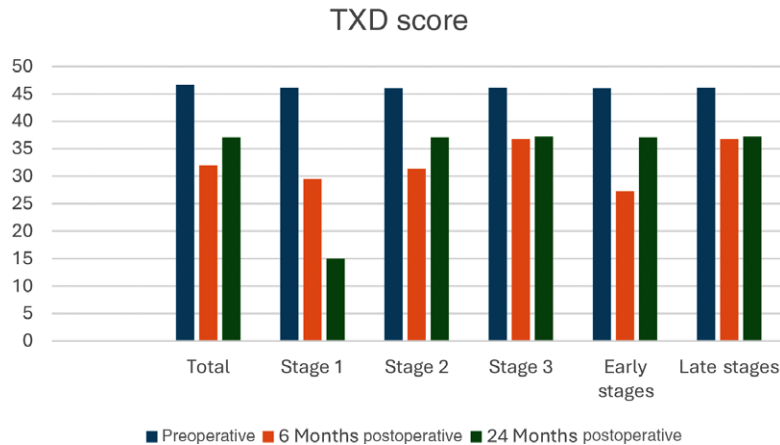
Regarding hand function, a significant gain in strength for the tip-to-tip pinch was observed after 24 months

Table 2. Statistical Analysis of Pain Reduction for Every Group

Pain Reduction (Visual Analog Scale Score)	Preoperative	6 Mo Postoperative	Two-sided <i>P</i> (6 Mo)	24 Mo Postoperative	Two-sided <i>P</i> (24 Mo)
Total	5.8	4.0	0.015	3.0	<0.001
Stage 1	5.0	1.5	0.395	1.5	0.323
Stage 2	5.3	3.7	<0.001	3.9	0.010
Stage 3	6.1	4.0	0.459	3.1	0.001
Early stages	5.7	3.7	<0.001	3.8	0.009
Late stages	5.8	4.0	0.457	3.0	<0.001

Table 3. Statistical Analysis of the TDX Score for Every Group

TDX Score	Preoperative	6 Mo Postoperative	Two-sided <i>P</i> (6 Mo)	24 Mo Postoperative	Two-sided <i>P</i> (24 Mo)
Total	46.7	32.0	<0.001	37.1	0.050
Stage 1	46.1	29.5	0.218	15.0	0.070
Stage 2	46.0	31.4	0.002	37.1	0.238
Stage 3	46.1	36.8	<0.001	37.2	0.067
Early stages	46.0	27.3	<0.001	37.1	0.196
Late stages	46.1	36.8	<0.001	37.2	0.041


Fig. 3. A bar chart that shows the results of the TDX score.

($P = 0.007$) and the palmar pinch after 6 ($P = 0.002$) and 24 months ($P = 0.039$) (Table 4).

No significance was observed for the tip-to-tip pinch after 6 months ($P = 0.1$), the lateral pinch after 6 ($P = 0.119$) and 24 months ($P = 0.820$), and the grip strength after 6 ($P = 0.815$) and 24 months ($P = 0.87$) (Fig. 4).

Complications

No complications were observed.

DISCUSSION

To our knowledge, this is the first study to examine the use of SVF in combination with PRP and stem cells for treating trapeziometacarpal arthritis. We modified the infiltration technique using autologous fat combined with PRP and observed that pain was significantly reduced in the entire study population over a follow-up period of 24 months. Also, the modified technique significantly decreased the TDX score and caused a significant gain in strength for the tip-to-tip and palmar pinches in the entire study population.

Winter et al²⁹ reported good pain relief and a reduction in the Disabilities of Arm, Shoulder and Hand score following fat and PRP infiltration in the thumb CMC joint. Similar results were observed in the present study, although hand function was assessed using the TDX score. Although the Disabilities of Arm, Shoulder and Hand score is widely used to examine hand function, the TDX score might be a better alternative because it is precisely designed for examining the thumb CMC joint.³¹

Some authors have reported considerable pain relief with autologous fat infiltration or infiltration with autologous fat combined with PRP.^{29,32} This combination reduces the fat resorption rate³³ and produces a thicker consistency that could result in a longer-lasting effect.²⁹ Furthermore, the combination of SVF and PRP has been discussed for its possible regenerative qualities^{25,34} in terms of cartilage regeneration.

The study participants were grouped according to the Eaton/Littler classification, and preoperative and postoperative (24 months) radiographs were examined and measured, but statistical analysis of the radiologic measurements was not part of this study. We observed a

Table 4. Statistical Analysis of Hand Function

Hand Function (kg)	Preoperative	6 Mo Postoperative	Two-sided p (6 Mo)	24 Mo Postoperative	Two-sided P (24 Mo)
Tip-to-tip pinch	3.4	3.8	0.100	6.1	0.007
Palmar pinch	3.7	5	0.002	4.9	0.039
Lateral pinch	6.1	6.3	0.119	6.2	0.820
Grip strength	23.8	24.1	0.815	27.2	0.087

**Fig. 4.** A bar chart that shows the results of the hand function.

noticeable increase in the joint gap after 24 months, possibly attributable to residual cartilage infiltration or regeneration. To verify these findings, another prospective study is warranted in which another imaging technique, such as magnetic resonance imaging-(positron emission tomography) computed tomography scan, should be performed to further reduce the possible bias of distorted images.

Interestingly, the reported pain severity showed no correlation with the Eaton/Littler classification. However, this classification may not be ideal for the future determination of patients for whom this procedure can be offered, as the procedure showed good results in terms of pain relief at all stages after the Eaton/Littler classification. For a better understanding of the correlation between pain and observed joint arthrosis on imaging, a prospective study with a positron emission tomography-computed tomography scan should be performed.

In our study, every procedure was performed under general anesthesia. All patients were discharged at least 6 hours after surgery the same day. A further decrease in invasiveness could be achieved through surgery under regional or local anesthesia, and patients can be discharged sooner with local anesthesia.

Possible limitations of this study include the lack of a control group, the retrospective study design, and the absence of a connection among study participants, which could result in potential bias. Further randomized controlled trials are needed in the future to confirm the data.

CONCLUSIONS

The intra-articular injection of ACP/SVF in patients with thumb CMC arthritis is a promising treatment option, in all stages, to improve pain symptoms and postpone

potential resection arthroplasty, with minimal surgical intervention and risks.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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