

Original Article

# NEW APPROACHES IN THE TREATMENT OF RHIZOARTHROSIS: RESULTS OF PROSTHETIC REPLACEMENT AND COMPARISON WITH TRAPEZIECTOMY AND SUSPENSION ARTHROPLASTY

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## ABSTRACT

Rhizoarthrosis is a degenerative disease of the first carpometacarpal joint; it causes pain and functional limitation of the thumb that progressively worsens until it affects the whole hand. The diagnosis is both clinical and radiological and the treatment in the early stages is conservative. When nonoperative measures fail, surgery is the only chance. There are many surgical options in the management of thumb arthrosis. The aim of this study is to compare the clinical and functional outcome after a prosthetic replacement vs trapeziectomy and suspension arthroplasty. From January 2020 to June 2021, 18 patients with diagnosis of rhizarthrosis (Eaton's grade II and III) were recruited from our unit. Eight patients were treated with prosthetic replacement while ten patients with trapeziectomy and suspension arthroplasty. The parameters evaluated were the first closure force, the index thumb grip force, the mobility of the first ray with the Kapandji score and the ROM of all the joints of the first ray. The follow up was performed at 3, 6, 12 months. The group of patients undergoing prosthesis replacement showed a statistically significant difference both in the force of the thumb-index forceps and in the Kapandji score following the removal of the post-surgical splint. Comparing the groups at 6 months there was no statistically significant difference in strength, while there was a statistically significant difference in range of motion in favor of the prosthesis ( $9+0.76$ ) over trapeziectomy ( $7.38+-1.32$ ). Comparing the groups at 12 months there was no statistically significant difference in range of movement, while there was a statistically significant difference strength in prosthetic group over trapeziectomy ( $10.37+-2.41$ ). Our study demonstrated a significant improvement in mobility and index thumb gripper strength in patients undergoing prosthetic replacement compared to patients undergoing trapeziectomy. The latter remains a valid therapeutic option in patients in whom prosthetic replacement is contraindicated, with a considerable improvement in pain symptoms and thumb functionality.

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**KEYWORDS:** *rhizarthrosis, osteoarthritis, trapeziometacarpal joint, surgical treatment, prosthetic replacement, trapeziectomy, suspension arthroplasty*

## INTRODUCTION

Rhizarthrosis is the second most frequent site of osteoarthritis in the hand after osteoarthritis of the distal interphalangeal joints, affecting about 33-66% of women over 55 years of age with radiographic diagnosis, with pain symptoms in about 22% of the population over 50 years of age (1). Prevalence increases with age and at post-menopausal age in women, with an F:M ratio of 6:1. Rhizarthrosis most commonly affects the nondominant hand joint. Despite the presence of radiographic signs frequently detected on radiographs, a fair proportion of patients will never develop symptoms such that treatment for the condition is required. In symptomatic cases, loss of function of the first ray results in up to 50% loss of function of the upper limb.

There is a close correlation between excessive laxity of the trapeziometacarpal joint and the subsequent development of arthrosis; increased laxity leads to incongruity of joint surfaces and thus cartilage and altered force transmission at the joint level (2, 3). Forces 13 times higher develop at the trapezius metacarpal joint than at the apex of the thumb, furthermore, compressive forces at the TMC joint increase 12 to 20 times during thumb-index clamping compared with the resting state (4). Ligamentous laxity is more common in women, even at a young age, and repeated overloading of a lax and subluxated joint explains the higher prevalence of rhizarthrosis in women over 50 years of age. Comparison of bone and joint morphology between the two sexes showed no significant differences, implying that the increased risk depends on physiological and functional factors. The hypothesis for this ligamentous laxity centers on the role of the hormone relaxin, which in women plays a key role in pelvic ligament laxity during pregnancy and childbirth; it is likely responsible for generalized laxity via an extracellular matrix metalloprotease signaling pathway (5). Pathologies involving soft tissues with ligamentous laxity also predispose to rhizarthrosis, such as Ehlers-Danlos syndrome; just as a higher Beighton score is associated with increased TMC mobility and increased risk of developing TMC arthrosis (6).

The most important ligaments in stabilizing the TMC joint are the anterior oblique ligament, the posterior oblique ligament, and the dorso-radial ligament. Previous studies placed more emphasis on the anterior oblique ligament, which in more recent anatomical studies has been found to be less important in stabilization than the posterior oblique ligament because of its less structural organization and less thickness.

The anterior oblique ligament with its intimate relationships with the Tenar eminence muscles, rich in mechanoreceptors, thus contributes to the stabilization of the joint. The tendons of the long thumb abductor, the long and short thumb extensors, and the long thumb flexor provide extrinsic stabilization. Intrinsic muscles that stabilize the first ray joints include the thumb short abductor, thumb adductor, thumb short flexor, and thumb oppositor (1). Prior trauma and fractures of the base of the I MC may predispose to rhizarthrosis, as well as jobs with repetitive and traumatic use of the thumb increase the risk 12-fold compared with the general population (7).

Inflammatory arthritis, first among them rheumatoid arthritis, are predisposing conditions. Approximately one third of patients with rheumatoid arthritis will develop clinically manifest rhizarthrosis.

The pain is predominantly activity-related, especially when using the index thumb clamp. It is a localized pain at the base of the first ray, often radiating to the Tenar eminence and toward the first metacarpophalangeal. With the progression of the pathology there is an increase in pain symptoms to the onset of pain even at rest, atrophy of the Tenar eminence muscles, subluxation of the first carpometacarpal joint, loss of the strength of the index thumb pincer, decrease in the range of motion of the first ray, and related loss of hand function. With further progression comes the inability to abduct the thumb, with complete loss of thumb opposition with the other fingers of the hand, until thumb collapse and a swan-neck deformity with adduction of the first metacarpal and hyperextension of the first metacarpophalangeal (8).

The conditions most frequently associated with rhizarthrosis are carpal tunnel syndrome, STT arthrosis, De Quervain's tenosynovitis, and trigger thumb. Of these, the most frequent is carpal tunnel syndrome, which is associated with rhizarthrosis in 43% of cases, more frequent in women and diabetic patients. Inflammation of the trapeziometacarpal joint can extend to the carpal tunnel, and conformational changes at the carpal bones reduce the tunnel space by compressing the median nerve.

## MATERIALS AND METHODS

Our study includes 18 patients referred to the Department of Orthopaedics and Traumatology of the Bari Polyclinic, operated between January 26, 2020 and June 1, 2021. Patients were evaluated with a minimum follow-up period of 12 months. The sample includes adult patients of both sexes, diagnosed with Eaton's Grade II or III, with worsening symptomatology and functional limitations in daily activities.

At the first visit and follow-up visits, fist closure strength was measured with an electronic dynamometer and thumb-index pincer strength. In addition, the mobility of the first ray was assessed with the Kapandji score and an evaluation of the ROMs of all joints of the first ray was performed. During the pre-admission examination were collected the following data:

- Biographical data
- Pathologic history and any prior trauma
- Patient's comorbidities
- Staging Rhizoarthrosis
- Objective examination and strength testing

Data collected at follow-up visits:

- Follow-up RX
- Objective examination and strength testing

The study includes two groups, patients operated with prosthetic replacement and patients operated with trapeziectomy and suspension plastic.

Prosthetic replacement was performed with Touch prosthesis with truncated acetabular component to avoid possible component loosening during thumb opposition movements. The above prosthesis requires a preoperative study for bone stock assessment for implantation of the acetabular component. Postoperative immobilization was maintained for 15 days with an antibrachio-metacarpal cast, and physiotherapy was initiated upon removal of the cast.

Trapeziectomy with suspension plastic was performed with the technique according to Ceruso, using the thumb long abductor tendon, using the most dorsal bundle if the thumb long abductor had a tendon consisting of multiple bundles.





The bundle of the thumb long abductor tendon was attached to the radial flexor of the carpus. Postoperative immobilization was maintained for 4 weeks, followed by use of the first ray brace exclusively at night and physical therapy was initiated 4 weeks after surgery.

In order to reach a correct diagnosis, all patients underwent a careful objective examination and instrumental exams (x-ray in 3P and EMG only in cases of altered sensitivity in the median nerve territory).

In the objective examination we considered: grind test (rotation of the base of the first metacarpal by applying a force in axial compression), distraction test or torque test(performed by rotating the base of the first metacarpal while applying a force in axial traction), the thumb-index pincer, weakness in the grip (1, 9).

In this recent study, an association between grip weakness and TMC arthrosis was demonstrated, even in the absence of radiographic signs (10). It must also be added that the Grind test does not always correlate with the degree of arthrosis shown by the X-ray.

The clinical diagnosis is confirmed by radiographs, taken in the three planes (PA, lateral, oblique). In addition, stress projections of the joint can be performed to demonstrate joint laxity by performing a posteroanterior projection of both trapeziometacarpal joints while the patient forcefully pushes the distal and radial ends of the thumbs against each other (11). It must be remembered that the degree of radiological staging does not always correlate with symptoms. After a careful objective and instrumental examination, we classified our patients according to Eaton's 4-stage classification, which is based only on radiographic changes (Fig 1).

Staging	Radiographic Characteristics	Stage I	Stage II	Stage III	Stage IV
Stage I	Normal or slightly widened trapeziometacarpal joint Normal articular contours Trapeziometacarpal subluxation (if present up to one third of the articular surface)				
Stage II	Decreased trapeziometacarpal joint space Trapeziometacarpal subluxation (if present up to one third of the articular surface) Osteophytes or loose bodies less than 2 mm in diameter				
Stage III	Further decrease in trapeziometacarpal joint space Subchondral cysts or sclerosis Osteophytes or loose bodies 2 mm or more in diameter Trapeziometacarpal joint subluxation of one third or more of the articular surface				
Stage IV	Involvement of the scaphotrapezium joint or less commonly the trapezotrapezoid or trapeziometacarpal joint to the index finger				

**Fig 1.** Eaton's Classification.

Although the most widely used, Eaton's classification is flawed in that it correlates only moderately with clinical and treatment protocols and has substantial inter-observer and intra-observer differences.

### Conservative treatment

In the first instance, the pathology is approached with treatment conservative, based mainly on modifying the activities in which the use of the first ray of the hand is prevalent, rest, use of the specific brace for rhizarthrosis, strengthening of the Tenar eminence muscles and anti-inflammatory therapy (8). At the first visit the patient is generally in the acute phase with marked pain and functional impotence, which is why the continuous use of the brace for 3 weeks, combined with anti-inflammatory therapy, is suggested. Subsequently the brace will be used intermittently, during the heaviest activities or when the pain is most present, associated with kinesitherapy, activity modification and joint protection education, possible physical therapy with magnetotherapy. Recent studies have examined the possible benefits of therapy with molecules with chondroprotective action in repairing joint damage and slowing cartilage degeneration.

The two most promising molecules are glucosamine sulphate and chondroitin sulphate (12). Corticosteroid infiltrations can be performed with medium-term benefit on pain symptoms, with actual risks only for repeated infiltrations with damage to the joint surface and capsule (6). Only in Eaton stage I was a response noted in 100% of cases with regression of symptoms at 18 months, the response to corticosteroid infiltrations in stages II and III drops to around 46% (13). Hyaluronic acid infiltrations have demonstrated long-term efficacy, with a slight initial worsening at 4 weeks with an increase in pain symptoms, but with improvement in pain symptoms at 12 and 26 weeks, with improvement in grip strength of the first finger (14). New conservative treatments are being studied, with promising results at short- and medium-term follow-up. The use of autologous adipose tissue obtained by liposuction and processed to increase the cellular component has proved effective at 12-month follow-up (15).

PRP (platelet-rich plasma) infiltration has also shown promising results, with improvement in the VAS scale and function as measured by different scores, both at 3 and 6 months after administration (16).

If conservative treatment does not bring any benefit in about two months, there is a debate about the surgical treatment to be performed.

### Surgical treatment

The primary indication for surgical treatment is no tolerable pain, not responsive to conservative treatment. There are various surgical approaches for rhizarthrosis, including the trapeziectomy with or without ligamentous reconstruction and plastic interposition (LRTI), trapeziometacarpal joint arthrodesis (TMA), arthroscopy with debridement, trapeziometacarpal prosthesis (17). The indication for the choice of surgical treatment to be performed depends not only on the experience of the surgeon, but also on the staging of the rhizarthrosis.

In patients under 50 years of age, with a need for joint stability and high-impact work activities, it is useful to consider TMA, with the downside of the increased risk of re-intervention, the risk of pseudo-arthrosis and the reduced mobility of the first radius, with subsequent development of arthrosis of the STT (6).

In early-stage rhizarthrosis with minimal joint damage, joint debridement and capsulorrhaphy has also been proposed, however evidence is still limited (18).

In more advanced stages but with isolated arthrosis at TMC, there is no clear indication of the surgical procedure to be performed. At this stage, prosthetic replacement with a trapeziometacarpal prosthesis has shown excellent results

with essentially equal long-term functionality but with an earlier return to activity and a shorter rehabilitation path compared to trapeziectomy (19). In advanced stages, with involvement of the entire trapezius surface and diffuse arthrosis at the STT, treatment options mainly include trapeziectomy, with possible additional surgical management such as stabilisation with k-wires or tendon interposition (Fig. 2) (20).



**Fig 2.** 61-year-old woman before and after prosthetic replacement for Rhizoarthrosis (Eaton 3).

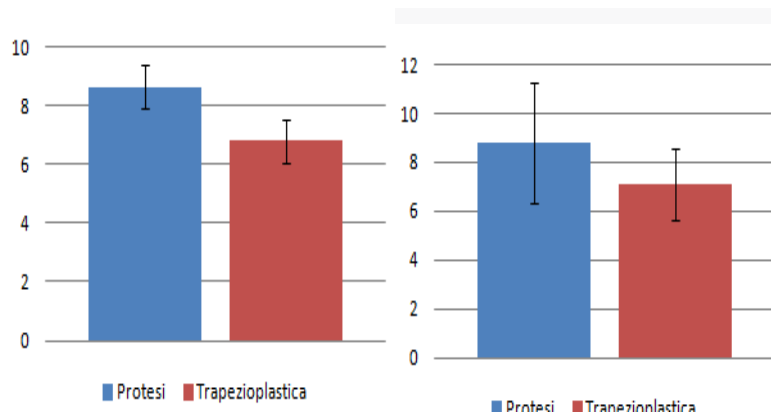
**RESULTS**

The dependent continuous variables of the two groups were expressed as mean and standard deviation or as median and interquartile range and compared using T test or Mann Whitney U for non-normal distributions. A significance threshold  $p < 0.05$  was considered in all comparisons.

In the study, 18 patients referred to the Orthopaedics and Traumatology of the Bari Polyclinic. The patients were assessed pre-operatively after conservative treatment and post-operatively, conservative and in the post-operative period, comparing the two surgical techniques with the pre-operative parameters and comparing them with each other.

No differences emerged in the two groups with regard to age, gender, pre-operative assessment of index thumb force and first ray mobility measured with the Kapandji score. In the prosthetised patients at the removal of immobilisation, a statistically significant difference emerged with a lower force in the operated group and a higher Kapandji score in the operated group.

In patients operated with suspension plastic upon removal of the immobilisation, a statistically significant difference emerged with lower levels of index thumb forceps, with a statistically significant improvement in ROM as measured by the Kapandji score. When comparing patients operated with the two surgical techniques at the removal of immobilisation, a statistically significant difference emerged in both index thumb clamp strength and Kapandji score in favour of prosthetic replacement (Fig. 3).

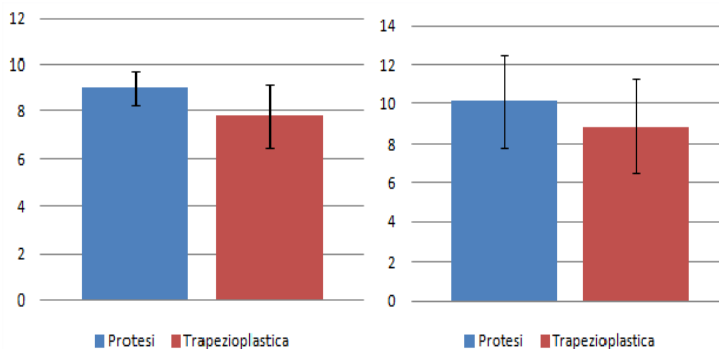


**Fig. 3.** Kapandji score and strength in two groups upon removal of immobilisation.

At the 6-month follow-up in the prosthetised patients, a statistically significant difference emerged with a non-full recovery of strength, but increased mobility as measured by the Kapandji score.

At the 6-month follow-up in patients operated with suspension plastic there was a progressive recovery of strength, but with statistically significant values in favour of pre-operative, and a further improvement in range of motion with a statistically significant difference.

Comparing the two groups at 6 months there was no statistically significant difference in strength, while there was a statistically significant difference in range of motion in favour of prosthesis (Fig. 4).

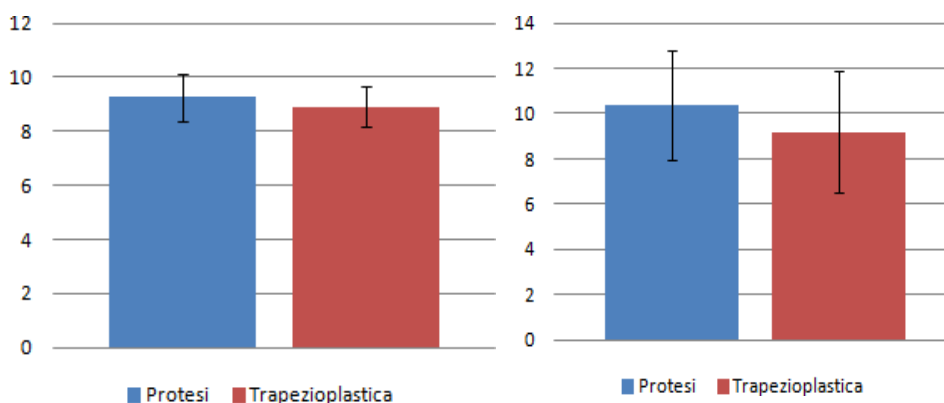


**Fig. 4.** Kapandji score and strength in two groups at 6 months follow-up.

At the 12-month follow-up in the prosthetised patients comparing pre-operative and post-operative values, mobility further improved with a statistically significant difference compared to pre-operative, and the recovery of strength was complete.

In the patients who underwent suspension plastic surgery, a further improvement in strength emerged at the 12-month follow-up, but a statistically significant difference remained in favour of the operated patients with regard to ROM as measured by the Kapandji score.

When comparing the two groups at 12 months, there was no statistically significant difference in range of motion, while there was a statistically significant difference in favour of the prosthetised patient group with regard to strength (Fig. 5).



**Fig. 5.** Kapandji score and strength in two groups at 12 months follow-up.

Hand function was also assessed pre-operatively, at 6 and at 12 months with a modified DASH score using items that significantly involved the first ray.

There was a marked improvement in both groups with a statistically significant difference at 6 months and 12 months compared to pre-operative.

The difference was greater than 10 DASH score points, which is the smallest clinically significant difference visible to the patient. Comparing the DASH score between the two groups of operated patients, at 6 months there was no statistically significant difference, while at 12 months there was a difference in favour of prosthetic replacement, but with a net difference of less than 10 points, the smallest clinically significant difference visible to the patient (Table I-II).

**Table I-II.** *Difference in DASH score between the two groups at 6 and 12 months follow-up.*

Table I.

	<b>Prosthetic replacement at 6 months (n=8)</b>	<b>Trapeziectomy and suspension arthroplasty at 6 months (n=10)</b>
<b>DASH score</b>	20	21
<b>Range interquartile</b>	18-22	19-28

Table II.

	<b>Prosthetic replacement at 12 months (n=8)</b>	<b>Trapeziectomy and suspension arthroplasty at 12 months (n=10)</b>
<b>DASH score</b>	10	15
<b>Range interquartile</b>	8,5-13,5	12-20

## DISCUSSION

In this study carried out in our Operating Unit it was confirmed the treatment course previously studied in the literature, with an initial conservative approach and a surgical approach as function deteriorated and symptoms worsened.

The patient sample was followed throughout the conservative treatment period, in which objective measurements of function and control X-rays were taken in addition to therapy. Subsequently, the patients underwent surgery for prosthesis of the trapeziometacarpal joint and trapeziectomy with suspension plastic according to Ceruso.

They were subsequently followed up for 12 months. Objective examinations with objective measurements and control X-rays were performed.

What emerged from the study was the substantial improvement in the function of the joint following surgery, with a large improvement in range of motion. The improvement was mainly visible at the trapeziometacarpal joint, with maintenance or slight improvement of range of motion at the MCF and FI. This improvement was not reflected in other parameters; the strength of the thumb-index clamp and the strength of the other four fingers remained virtually unchanged.

Differences emerged between the two surgical techniques with regard to mobility and strength on removal of post-operative immobilisation, in favour of prosthetic replacement.

At follow-up at 6 months the group operated with suspension plastic had recovered strength but the gap in range of motion in favour of prosthesis was still marked. The DASH score was superimposable at 6 months. At one year, mobility was significantly improved in both groups, with total recovery of strength in the group operated with the Touch prosthesis and partial recovery of strength in the patients operated with trapeziectomy and suspension plastic, with a better DASH score in the group operated with the prosthesis.

## CONCLUSIONS

The present study performed at our OU, comparing the two most common surgical approaches, demonstrated a significant improvement in DASH score, mobility and index thumb grip force in patients operated with joint prosthesis, more markedly than in the control group operated with trapeziectomy and suspension plastic, which remains a feasible procedure in patients in whom prosthetic replacement is contraindicated, with marked improvements in patient symptomatology and first ray function.

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