



An Effect Of Therapeutic Ultrasound And Grip Strengthening Exercise In Post-Operative Dorsal Wrist Ganglion Cyst: A Case Study

Mageswaran Nagarajan³, Arpit Shukla¹, Kritika Maharjan², Akhila K³, Sreelekshmi A⁵

1. Principal, Aditya College of Physiotherapy, Bangalore, India
2. Assistant Professor, Aditya College of Physiotherapy, Bangalore, India.
3. Intern, Aditya College of Physiotherapy, Bangalore, India
4. Lecturer, Aditya College of Physiotherapy, Bangalore, India
5. Clinical Physiotherapist, Aditya College of Physiotherapy, Bangalore, India

Abstract

Wrist ganglion cyst is a fluid-filled lump that occurs near a joint or tendon in the wrist. 60% to 70% wrist ganglion cyst is present on the dorsal aspect, often arising from dorsal scapho-lunate ligament while only 13% to 20% of ganglion cysts is present on volar aspect. It feels much like a firm rubber ball while on palpation. These are usually painless but it may compress nearby structures, causing discomfort to the patient. The symptoms for ganglion cyst include palpable mass, aching in the wrist that may also radiate up to the patient's arm, tenderness, pain while performing activity, weakness of grip strength and decreased range of motion. Conservative and surgical approaches have been used for treatment of the cyst. Various conservative treatment methods are also suggested such as reassurance, aspiration, sclerosant injection, and direct compression. But, acceptable treatment of choice is still not known, because each suggested method has high chance of recurrence rate. So, a case study of 23-year-old female with recurrence of dorsal wrist ganglion cyst after a month of surgical procedure was taken for the physiotherapy management using therapeutic ultrasound along with grip strengthening exercise for 3 weeks. This study shows the effectiveness of therapeutic ultrasound along with the grip strengthening exercise which had improved this condition with our targeted aims and objectives.

Study Design: A Case Report

Database: A Computer- Aided Literature Search Was Performed in the Following Electronic Databases Pubmed, Google Scholar, Research Gate.

Keyword: Ganglion cyst, Therapeutic Ultrasound, Strengthening Exercise

Introduction

Ganglion cysts are one of the most common soft tissue tumors of the hand and wrist, affecting paediatric as well as adult populations. These are well-defined, mucin-filled and often multilobulated lesions that arise from joints or tendons of the hand and wrist ^[1]. Ganglion cyst, most commonly affects on the dorsal aspect of the wrist with 60% to 70% occurrence rate, often arising from the dorsal scapho-lunate ligament while 13% to 20% of cysts are found on the volar aspect of the wrist. Ganglion cysts generally originate from connective tissue such as joint capsules, tendon sheaths, and less commonly occurs within the bone. These contain highly viscous fluid that contain mainly of hyaluronic acid and less amounts of glucosamine, globulins and albumin ^[2]. Incidence rate in males is 25/100,000 and in females 43/100,000. Prevalence is 19% in patients reporting wrist pain and 51% in the asymptomatic population. On examination, wrist ganglion is usually 1–2 cm in its structure and feels like a firm rubber ball on palpation that is well placed by its attachment to the underlying joint capsule or tendon sheath. There is no any presence of warmth or erythema in and around the cyst ^[3]. The majority of cysts are asymptomatic in its nature and sometime may also cause symptoms depending on their location through pressure on the adjacent areas. These cysts are usually painless but it compresses the nearby structures, causing discomfort and pain at rest or even during activities ^[4]. The common symptoms and indication for ganglion includes: palpable mass, aching in the wrist joint that may also radiate up to the patient's arm, tenderness, pain with activity, weakness of grip and decreased range of motion ^[5]. The dorsal wrist ganglion is most easily palpable and visible in a position when patient perform wrist flexion. Volar ganglia sometimes may also cause paraesthesia because of compression of the ulnar or median nerves or their branches.

Open surgical excision is one of the gold standards for the treatment of ganglion cysts. In 2015, a systematic review by Head and colleagues reported, 76% and 58% reduction in the reoccurrence of ganglion cyst is seen while compared with aspiration in randomized controlled trials and cohort studies, respectively. However, recurrence rates ranging from 7-43% is likely attributed to occur due to imperfect excision and surgeon experience ^[9, 2].

This case report illustrates the conservative management of a ganglion cyst of the dorsal wrist using the therapeutic ultrasound along with grip strengthening exercises. Therapeutic Ultrasound is a form of longitudinal sound energy with a deep penetration. Initially when an ultrasound is given, electrical energy is converted into mechanical head once the energy pass through the transducer head ^[10]. Ultrasound refers to mechanical vibrations which are essentially the same as sound waves but of a higher frequency. Ultrasonic energy generated at 1 MHz is transmitted through the more superficial tissue and absorbed primarily in the deeper tissues at depths of 3 to 5 cm. A 1 MHz frequency is most useful in individuals with a high percentage of cutaneous body fat and whenever the desired effects are in the deeper structures. At 3 MHz, the energy is absorbed in the more superficial tissues with a depth of penetration between 1 and 2 cm. Instruments for measuring the Hand Grip Strength (HGS) can be divided into four types, depending upon their principles such as: a) Hydraulic dynamometer, b) Pneumostatic dynamometer, c) Spring- type dynamometer, d) Strain – hand dynamometer. Among these, Spring- type dynamometer which include CAMRY dynamometer with validity and reliability is widely recommended device used to measure handgrip strength and is simple, inexpensive and accurate ^[14]. One of the self-assessment outcome scales with validity and reliability that can be used to determine the level of pain and disability in wrist problems is Patient Rated Wrist Evaluation (PRWE) scale. It is a questionnaire which consists of 15 questions that measures the severity of wrist pain and the level of disability in daily living activities. It is divided into two subsections: The pain subsection that consists of 4 questions on the intensity and frequency of pain; The function subsection that consists of 6 questions on specific activities and 4 questions on usual activities. Each response is scored between 0 and 10 (0 = no pain/strain; 10 = maximum pain felt/inability to do anything). The total score is calculated out of 100, Higher score indicates more pain and functional disability and 0 score indicates no disability ^[15].

Need of the study

Effectiveness of therapeutic ultrasound along with grip strengthening exercise on pain, grip strength and functional activity level in patient with dorsal wrist ganglion remains limited. Evidence have reported that, people with wrist ganglion have linked with mild discomfort, reduced intrinsic muscle strength, slightly reduced grip strength and limited functional activity level of hand [16]. There is lack of thorough studies on how effective therapeutic ultrasound along with the grip strengthening exercise is specifically for treating dorsal wrist ganglion. Therefore, the need of my study is to evaluate the effectiveness of therapeutic ultrasound along with grip strengthening exercise to reduce discomfort and pain, increase grip strength, increase intrinsic muscle strength and improve functional activity of hand in post-operative dorsal wrist ganglion patient.

Aims

The aim of the study is to evaluate the effectiveness of therapeutic ultrasound along with grip strengthening exercise in post- operative dorsal wrist ganglion cyst.

Objective

To reduce pain and discomfort, to improve the muscle strength of wrist and hand, to improve Range of Motion (ROM) of wrist, to improve the grip strength.

Case Description

A 23-year-old female complained of pain and mild discomfort in wrist joint since 7 month and having difficulty in performing daily activities. Pain aggravates while doing household activities and alleviates at rest. She stated that the cyst began unknowingly 3 years prior in the year 2021 and had remained since with on and off of the cyst. The ganglion reportedly made difficult for the patient to perform her daily activities. Due to this the patient visited nearby hospital and doctor notified her it is a ganglion cyst and gave painkiller and suggested her to do surgery if the size of the cyst further increases. Pain was subsided so she didn't visit the hospital. It remained with on and off of the cyst. But after a year the size of the cyst increased and made even more difficult for the patient to perform her daily activities with some mild pain and discomfort. So, she notified her known general surgeon of the cystic mass and was consulted, who instructed her it is a ganglion cyst and that no further diagnosis imaging was needed. Surgeon suggested to undergo surgery of the cyst. So, open incision surgery for dorsal wrist ganglion cyst was done on 4th January, 2024. But again, after a month of surgery, ganglion cyst re-occurred gradually and had remained since with on and off of the cyst with pain and discomfort.

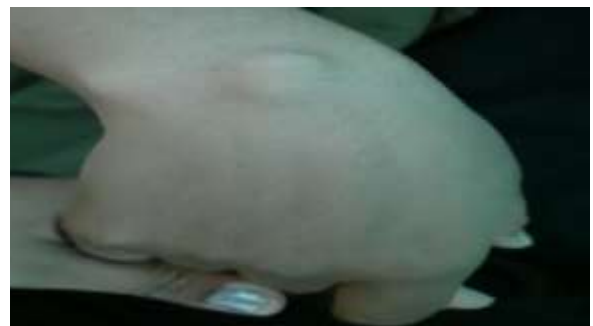


Fig 5: Ganglion Cyst Before Surgery



On Assessment patient complained of pain and mild discomfort in wrist joint since 7 month and having difficulty in performing daily activities. Pain aggravates while doing household activities and alleviates at rest. Patient do not had a history of fall and any other personal history. On observation, incision scar presents over dorsal area of right wrist, skin color is dark surrounding scar. On palpation, the ganglion cyst was mobile and soft and tenderness was present with Grade 1 over the area of the cyst. On Examination, the size of the incision scar is 1 inch. Active range of motion (AROM) and passive range of motion (PROM) for elbow and wrist for each hand was measured which is shown in Table No. 1. Manual Muscle Testing (MMT) of elbow, forearm and wrist for each hand was measured which is shown in Table No. 2 and grip strength was also measured using Camry Dynamometer in three different range for both the hand which is shown in Table No. 3. At the initial evaluation the patient completed a Visual Analogue Scale (VAS) with the score of 5/10 and PRWE with the score of 21/50 on the Pain scale, and 13/50 on the Function scale and for a total score of 34/100

JOINT	MOVEMENT	ON ASSESSMENT: AROM (RIGHT)	ON ASSESSMENT: AROM (LEFT)	ON ASSESSMENT: PROM (RIGHT)
WRIST	FLEXION	0-80°	0-80°	0-80°
	EXTENSION	0-62°	0-70°	0-66°
	RADIAL DEVIATION	0-20°	0-20°	0-20°
	ULNAR DEVIATION	0-30°	0-30°	0-30°
ELBOW	SUPINATION	0-80°	0-80°	0-80°
	PRONATION	0-80°	0-80°	0-80°

MUSCLE	RIGHT	LEFT
ELBOW FLEXORS	Grade 5	Grade 5
ELBOW EXTENSORS	Grade 5	Grade 5
FOREARM SUPINATORS	Grade 5	Grade 5
FOREARM PRONATORS	Grade 5	Grade 5
WRIST FLEXORS	Grade 5	Grade 5
WRIST EXTENSORS	Grade 4	Grade 4

Table No. 1: Range of Motion (pre- treatment)

Table No. 2: Manual Muscle Testing (pre-treatment)

	Pre-test value in kg (Right)	Pre-test value in kg (Left)
Initial Range	20.62	19.5
Mid Range	21.0	20.5
End Range	19.8	19.3

Table No. 3: Hand Grip Strength (pre-treatment)

Methodology

Study duration: 4 weeks

Number Of Subjects: 1

Study design: Case Study

Subject Source: Patient home, Maruthinagar, Kogilu Main Road, Bangalore

Duration Of Treatment: 3 weeks

Materials Used: CAMRY Dynamometer, Goniometer, measuring tape, therapeutic ultrasound, smiley ball, cotton cloth, half liter water bottle, 1 liter water bottle, clay, dough, sand, silicon finger stretcher

Procedure

This study started once the consent form was read and signed by the patient. The patient underwent 15 sessions lasting 30 minutes of treatment duration for 5 times a week for total 3 weeks of time period. Therapeutic Ultrasound with pulsed mode 1:1, intensity of 0.5 W/cm^2 for 10 minutes and routine physiotherapy exercises was given during this time period. Before each ultrasound therapy treatment, the area was cleaned with water, in order to remove any substance applied to the skin. To perform the treatment, patient was positioned seated, with the arm close to the trunk, shoulder in slight flexion, elbow flexion with forearm supported in the table, forearm in pronation and wrist in neutral. The transducer was attached to the skin over the cyst region, using gel as a conductive medium, remaining in direct and continuous contact with the skin for the duration of the therapy, using circular movements. After 10 minutes of ultrasound, the patient was made to perform the routine physiotherapy treatment.

In 1st week of treatment initially, therapeutic ultrasound was given as procedure mentioned above. Then routine physiotherapy was given that includes AROM of wrist flexion and extension for 10 repetition, 2 sets; squeezing smiley ball for 5 seconds hold, 10 repetition, 2 sets and squeezing a cotton cloth for end range 5 seconds hold, 10 repetition, 2 sets was done.

In 2nd week of treatment initially, therapeutic ultrasound was given as procedure mentioned above. Then routine physiotherapy was given that includes AROM of wrist flexion and extension for 15 repetition, 2 sets; squeezing smiley ball for 10 seconds hold, 15 repetition, 2 sets; squeezing a cotton cloth for end range 10 seconds hold, 15 repetition, 2 sets; wrist curl and reverse wrist curl using half liter water bottle for 10 second hold, 10 repetition, 2 sets and some functional activities using clay and dough was done.

In 3rd week of treatment initially, therapeutic ultrasound was given as procedure mentioned above. Then routine physiotherapy was given that includes AROM of wrist flexion and extension for 15 repetition, 3 sets; squeezing smiley ball for 10 seconds hold, 15 repetition, 3 sets; squeezing a cotton cloth for end range 10 seconds hold, 15 repetition, 3 sets; wrist curl and reverse wrist curl using 1 liter water bottle for 10 second hold, 10 repetition, 3 sets; some functional activities using clay, dough, sand; silicon finger stretcher for resisted finger extension exercise for 10 sec hold, 10 repetition, 2 sets was done.

By the end of 3rd week of treatment, reassessment of patient was done. The incision scar color became light and the size of the cyst slightly decreased as compared to the first day of assessment., AROM and PROM for elbow and wrist for right hand was measured which is shown in Table No. 4, MMT of elbow, forearm and wrist for right hand was measured which is shown in Table No. 5 and hand grip strength was also measured using Camry Dynamometer in three different range for right hand which is shown in Table No. 6. At the end of the session patient again completed VAS with the score of 3/10 and PRWE with the score of 17/50 on the Pain scale, and 9/50 on the Function scale and for a total score of 26/100.



JOINT	MOVEMENT	AROM (RIGHT)	PROM (RIGHT)
WRIST	FLEXION	0-80°	0-80°
	EXTENSION	0-68°	0-70°
	RADIAL DEVIATION	0-20°	0-20°
	ULNAR DEVIATION	0-30°	0-30°
ELBOW	SUPINATION	0-80°	0-80°
	PRONATION	0-80°	0-80°

Table No. 4: Range of Motion at end of the treatment

MUSCLE	RIGHT
ELBOW FLEXORS	Grade 5
ELBOW EXTENSORS	Grade 5
FOREARM SUPINATORS	Grade 5
FOREARM PRONATORS	Grade 5
WRIST FLEXORS	Grade 5
WRIST EXTENSORS	Grade 5

Table No. 5: Manual muscle Testing at end of the treatment

	Post treatment value in kg (Right)
Initial Range	22.3
Mid Range	22.5
End Range	21.7

Table No. 6: Hand grip Strength at end of the treatment

Rehabilitation Protocol

GOALS

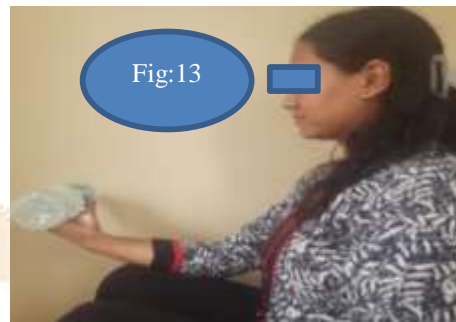
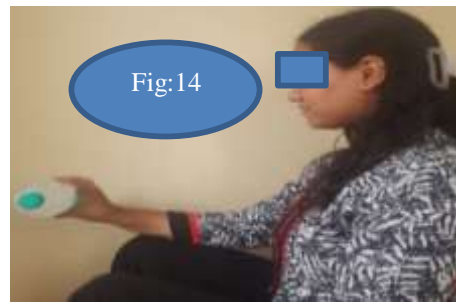
- To reduce mild discomfort and pain.
- To improve intrinsic muscle strength and endurance.
- To improve grip strength.
- To make easier in performing household activities.

WEEK	INTERVENTION
1 st Week	<ol style="list-style-type: none">1. Therapeutic Ultrasound2. Hand Squeeze3. Free ROM exercises of fingers and wrist
2 nd week	<ol style="list-style-type: none">1. Continue with above physiotherapy intervention2. Wrist Curl3. Reverse wrist Curl4. Functional activities
3 rd week	<ol style="list-style-type: none">1. Continue with above intervention2. Resisted Finger Extension

Fig: 8

Fig:9





RESULT

A 23-year-old female patient with right post-operative dorsal wrist ganglion cyst was treated with therapeutic ultrasound along with strengthening exercises. Before starting the intervention, patient was thoroughly assessed for pain; ROM of elbow, forearm and wrist; muscle strength of elbow and wrist. VAS and PRWE outcome measures were used for evaluating the pain and functional activity and MMT and goniometer was used for assessing the muscle strength and ROM respectively. During pre-assessment VAS score was 5/10, PRWE on the day of assessment was with the score of 21/50 on the Pain scale, and 13/50 on the Function scale and for a total score of 34/100. All ROM of right forearm and wrist had full range except wrist extension which is 0° - 62° for AROM and 0° - 66° for PROM. MMT for elbow, forearm and wrist had full strength except wrist extensors which is of grade 4. For hand grip strength, initial range of right hand was 20.62kg and left hand was 19.5kg, mid-range of right hand was 21.0kg and left hand was 20.5kg and end range for right hand was 19.8kg and left hand was 19.3kg. The skin surrounding the incision scar was dark on the day of assessment. After pre-assessment patient was provided with therapeutic ultrasound and strengthening exercises for hand, wrist and forearm for 5 days a week for total 3 weeks of time period. After completion of total 3 weeks of time period, patient was re-assessed. Hence, post assessment shows VAS score with 3/10. PRWE score shows 17/50 on the

Pain scale, and 9/50 on the function scale and for a total score being 26/100. AROM of wrist extension progressed to 0° – 67° and PROM progressed to 0° – 70° . MMT also improved to grade 5. Hand grip strength improved to 22.3kg, 22.5kg and 21.7kg for initial, mid and end range respectively. Skin color became slightly light surrounding the incision scar. The size of cyst also reduced slightly as compared to the day of assessment. All the pre and post result of ROM examination, MMT, hand grip strength, VAS and PRWE score shows the improvement at the end of 3 weeks of treatment session for post-operative dorsal wrist ganglion cyst.

DISCUSSION

A wrist ganglion occurs relatively often and can be diagnosed relatively easy by clinical symptoms. This case study reports outcome especially for patient with post – operative dorsal wrist ganglion cyst using physical therapy management including the use of multi-treatment approach protocol. Pain and functional level were measured with patient PRWE which shows good reliability and validity. Gomez-Eslava B et. al. has shown good reliability and validity of PRWE with Cronbach's Alpha (>0.91) and spearman's coefficient (0.82). Hand grip strength was measured using Camry Hand Dynamometer. Sanchez-Aranda L et.al. has shown good validity and reliability of Camry hand dynamometer.

Subject with dorsal wrist ganglion shows pain, discomfort and reduced grip strength of hand. Therapeutic ultrasound and grip strengthening exercises are shown to be effective in reducing pain and discomfort and has also shown effectiveness to increase hand grip strength. These has also shown reduction in the size of ganglion cyst and there is speed of recurrence of dorsal wrist ganglion. This shows result in consistent with Julia Pancotte et.al., as it showed improvement in pain, discomfort and the size of the volar wrist ganglion cyst with the pulsed therapeutic ultrasound. Safran T et. al. has shown that there is a reduction in hand grip strength after surgery of the wrist ganglion.

In present study, pre assessment and post assessment value has shown improvement in pain, discomfort and also there was improvement in hand grip strength, ROM of right wrist extension and MMT for wrist extensors. Pre assessment data shows PRWE score 34/100, hand grip strength with initial range, mid range and end range was 20.62, 21.0, 19.8kg of right hand respectively. There was decreased right wrist extension i.e. ROM 62° . There was grade 4 of MMT wrist extensors. Post assessment data shows PRWE score 26/100, hand grip strength with initial range, mid range and end range 22.3, 22.5 and 21.7kg of right hand respectively and ROM of right wrist extension 68° . MMT of wrist extensors improved to grade 5. Post assessment data has shown that pulsed therapeutic ultrasound and grip strengthening exercises was effective in reducing pain, improvement of ROM and improvement in grip strength and improvement in overall function of wrist joint compare to pre assessment data. Glenn J. crafts DC et. al. has shown effectiveness of hand grip strengthening exercises along with pulsed ultrasound and chiropractic management which reduces hand discomfort and numbness in interosseous ganglion cysts. Above all data support that there was improvement with pulsed therapeutic ultrasound along with grip strengthening exercises and patient reported that there is reduce discomfort and pain after the intervention. As patient has history of recurrent ganglion cyst after 1 month of open incisional surgery, cyst was present in on and off manner, during our study we have found there was reduction in diameter of cyst in post assessment picture as compare to pre assessment and there was reduction in speed of reoccurrence. Duration of our study was 4 week and treatment duration is 3 week and intervention had given 5 times in a week with total 15 session which shows improvement with pulsed therapeutic ultrasound. Present study does not show any evidence with continuous therapeutic ultrasound. Past literatures show continuous therapeutic ultrasound did not show improvement in pain and size of ganglion cyst. Further study is needed to evaluate the recurrent of dorsal ganglion cyst and size of the ganglion cyst. More evaluation is needed for different age group and different gender to see the effect of pulsed ultrasound and effect on grip strength.

CONCLUSION

This case study concluded that pulsed mode of therapeutic ultrasound along with strengthening exercises was effective in treating the post operative dorsal wrist ganglion. Pulsed mode of therapeutic ultrasound along with exercises showed a significant improvement in reduction of pain, reduced the size of the cyst, reduction in difficulties in carrying out activities, improved the muscle strength and improved the hand grip strength and the further studies will help to do in a large population to give the rehabilitation protocol to post-operative dorsal wrist ganglion.

CONFLICT OF INTEREST

There is no conflict of interest

REFERENCE

1. Zhou J, Al-Ani S, Jester A, Oestreich K, Baldrighi C, Ting JW. Wrist Ganglion Cysts in Children: An Update and Review of the Literature. *HAND*. 2022 Nov;17(6):1024-30. ^[1]
2. Kissel JA, Wong C. Ganglion cyst of the wrist treated with electroacupuncture: a case report. *The Journal of the Canadian Chiropractic Association*. 2017 Dec;61(3):269. ^[2]
3. Meena S, Gupta A. RETRACTED: Dorsal wrist ganglion: Current review of literature. *Journal of clinical orthopaedics and trauma*. 2014 Jun 1;5(2):59-64. ^[3]
4. Alhamad M, Mahfoud M, Alsmail H, Masdouh M, Alasaad H, Ibrahim J. A rare case of Ganglion cyst in the thigh in a 44-year-old woman: A case report and literature review. *International Journal of Surgery Case Reports*. 2024 Jun 4:109817. ^[4]
5. Chaudhary S, Mandal S, Kumar V. Results of modified thread technique for the treatment of wrist ganglion. *Journal of Clinical Orthopaedics and Trauma*. 2021 Feb 1;13:57-62. ^[5]
6. Konigsberg MW, Tedesco LJ, Mueller JD, Ball JR, Wu CH, Kadiyala RK, Strauch RJ, Rosenwasser MP. Recurrence rates of dorsal wrist ganglion cysts after arthroscopic versus open surgical excision: A retrospective comparison. *Hand*. 2023 Jan;18(1):133-8. ^[7]
7. Federer AE, Yoo M, Stephens AS, Nelson RE, Steadman JN, Tyser AR, Kazmers NH. Minimizing costs for dorsal wrist ganglion treatment: a cost-minimization analysis. *The Journal of hand surgery*. 2023 Jan 1;48(1):9-18. ^[8]
8. Pancotte, Julia & Finato, Elisiane & Tansini, Suélen & Pimentel, Gilnei & Otávio, Luiz & Gama, Rosa. (2016). Use of therapeutic ultrasound in wrist ganglion cyst: case study. *Fisioterapia Ser*. 11. 170-173. ^[10]
9. Jagmohan Singh, *Textbook of Electrotherapy - Second Edition*, 2012, page no. 245, 246, 250^[11]
10. Michlovitz, S. L., Harris, B. A., & Watkins, M. P. (2004). "Therapeutic Exercises for Musculoskeletal Injuries." *Journal of Hand Therapy*, 17(2), 105-118. DOI: 10.1197/j.jht.2003.10.001. ^[13]
11. Huang L, Liu Y, Lin T, Hou L, Song Q, Ge N, Yue J. Reliability and validity of two hand dynamometers when used by community-dwelling adults aged over 50 years. *BMC geriatrics*. 2022 Jul 15;22(1):580 ^[14].
12. Ozturk O, Sari Z, Ozgul B, Tasyikan L. Validity and reliability of the turkish" patient-rated wrist evaluation" questionnaire. *Acta Orthop Traumatol Turc*. 2015 Mar 1;49(2):120-5 ^[15].
13. Safran T, Hazan J, Al-Halabi B, Al-Naeem H, Cugno S. Scaphoid cysts: literature review of etiology, treatment, and prognosis. *Hand*. 2019 Nov;14(6):751-9 ^[16].
14. Sanchez-Aranda L, Fernandez-Ortega J, Martín-Fuentes I, Jurak G, Ruiz JR, Csányi T, Ortega FB. Reliability and criterion validity of a low-cost handgrip dynamometer: The Camry. *medRxiv*. 2024:2024-06 ^[17].

15. He H, Pan L, Wang D, Liu F, Du J, Pa L, Wang X, Cui Z, Ren X, Wang H, Peng X. Normative values of hand grip strength in a large unselected Chinese population: Evidence from the China National Health Survey. *Journal of Cachexia, Sarcopenia and Muscle*. 2023 Jun;14(3):1312-21 ^[18].
16. Gomez-Eslava B, Rodriguez-Ricardo MC, Serpa JC, Fajury R, García-González LA. Cross-cultural adaptation and validation of the translated patient-rated wrist evaluation score. *Journal of Wrist Surgery*. 2021 Aug;10(04):303-7 ^[20].
17. Crafts GJ, Snow GJ, Ngoc KH. Chiropractic management of work-related upper limb disorder complicated by intraosseous ganglion cysts: a case report. *Journal of Chiropractic Medicine*. 2011 Sep 1;10(3):166-72 ^[24].

