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Physiotherapy Management of Wrist Drop: Clinical Assessment, Rehabilitation and Three Case Reports

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Abstract: ***Background**: Wrist drop is characterized by loss of active wrist and finger extension and is commonly associated in the presented thesis with radial nerve injury. The resulting motor and sensory deficits may interfere with grasp, object handling and self-care. The level and severity of nerve injury influence the clinical presentation and the rehabilitation approach. **Objective**: To present the clinical features, assessment, investigations and physiotherapy management of wrist drop described in the source project report, together with the clinical details and treatment progression of three reported cases. **Methods**: This manuscript is a descriptive synthesis of the material contained in the undergraduate project report "Physiotherapy Management of Wrist Drop." The source includes an overview of radial nerve anatomy, mechanisms and classifications of peripheral nerve injury, clinical assessment and investigations, conservative and postoperative physiotherapy approaches, and three individual case descriptions. No additional patients, measurements, interventions or outcomes have been introduced. **Clinical presentation**: The three cases comprised a 45-year-old man with radial nerve neuropraxia at the spiral groove following prolonged compression during sleep; a 42-year-old man with left wrist drop following fracture of the proximal third of the radius and internal fixation; and a 35-year-old woman with right wrist drop following an injection. The first case demonstrated improvement in extensor muscle power, sensation, supinator reflex and functional activities during the reported treatment period. The second case showed improvement in shoulder and elbow movement and muscle power to grade 2 by day 7, with active-assisted exercise and further mobilization subsequently described. In the third case, no remarkable improvement was recorded by day 7; the patient did not wear the advised splint and discontinued attendance. **Conclusion**: The source report illustrates the importance of identifying the site and type of radial nerve injury, assessing motor, sensory and functional deficits, protecting the involved limb, maintaining joint mobility, supporting muscle re-education and progressing exercise according to recovery. Patient education, adherence and coordinated rehabilitation are emphasized.*

Keywords: wrist drop; radial nerve injury; physiotherapy; peripheral nerve injury; splinting; rehabilitation.

1. Introduction

Peripheral nerves connect the brain and spinal cord with the rest of the body and are susceptible to external compression and entrapment by adjacent anatomical structures. The radial nerve may be compressed along its course, including in the spiral groove of the humerus. The resulting clinical problem may include pain, weakness and sensory disturbance in the distribution of the nerve. The extent of impairment depends on the severity and anatomical level of the lesion [1,5,6].

Wrist drop is described in the source thesis as a condition in which the wrist and fingers cannot extend at the metacarpophalangeal joints. The wrist remains partly flexed because the forearm flexors act without balanced activity from the paralyzed extensor muscles of the posterior compartment. Although radial nerve injury is a major cause discussed in the report, the thesis also distinguishes patterns associated with posterior interosseous nerve, C7–C8 and corticospinal lesions.

The functional consequences may extend beyond loss of wrist position. Patients may have difficulty grasping and holding objects, using the hand during daily activities and maintaining independence in self-care. Pain, altered sensation, muscle wasting, reduced reflexes and trophic changes may accompany the motor deficit. The report therefore emphasizes assessment of the complete upper limb and the functional impact of the lesion, rather than considering wrist extension in isolation [4,9,12].

This manuscript consolidates the source report's discussion of radial nerve anatomy, aetiology, pathology, classification, clinical assessment, investigations and physiotherapy management. It also presents the three cases described in the thesis. The manuscript is descriptive and does not add external evidence or infer outcomes that were not recorded in the source.

2. Relevant Anatomy and Pathophysiology

2.1 Radial nerve anatomy

The radial nerve is described as the largest branch of the posterior cord of the brachial plexus, with root values C5, C6, C7, C8 and T1. It passes through the axilla, travels posteriorly in the arm in the radial groove in close relation to the humerus, and then pierces the lateral intermuscular septum to enter the anterior compartment of the arm. In the cubital fossa, it divides into a superficial terminal branch and a deep terminal branch. The deep branch passes through the supinator and continues as the posterior interosseous nerve, while the superficial branch is cutaneous and supplies the lateral part of the dorsum of the hand and the proximal dorsal surfaces of the thumb, index and middle fingers [1,5,6].

Motor branches supply muscles involved in elbow, forearm, wrist, finger and thumb extension, including triceps, brachioradialis, extensor carpi radialis longus and brevis, supinator, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris, extensor indicis and the thumb extensors. The distribution of weakness and sensory loss therefore varies according to the level of injury [1,5,6].

2.2 Pathological changes following nerve injury

The thesis describes several changes following axonal injury: Wallerian degeneration distal to the lesion, retrograde degeneration proximal to it, transneuronal degeneration, chromatolysis, segmental demyelination and nerve regeneration. Wallerian degeneration involves fragmentation of the distal axon and myelin sheath. Schwann cells proliferate and macrophages participate in the clearance of axonal debris. Regeneration is described as growth of axonal sprouts from the surviving proximal segment. The report notes that preservation of the endoneural tubes facilitates the passage of regenerating fibres, whereas disruption and scar formation may lead to disorganized growth [6,13].

The source report describes axonal regeneration at approximately 1 mm per day and a proximal-to-distal sequence of muscle reinnervation, referred to as the "motor march." These statements are reproduced as presented in the thesis and are not independently updated or verified in this manuscript.

2.3 Classification of nerve injury

Seddon's classification in the thesis includes neuropraxia, axonotmesis and neurotmesis. Neuropraxia is described as a functional interruption of conduction without anatomical discontinuity of the nerve, with recovery generally expected over days or weeks. Axonotmesis involves axonal disruption and distal Wallerian degeneration with preservation of Schwann cell and endoneural structures, allowing regeneration. Neurotmesis represents severe structural disruption of the nerve and its connective tissue coverings, for which significant spontaneous recovery is not expected [6,8,11].

The report also presents Sunderland's five-degree classification, arranged according to increasing disruption of the axon, endoneural tubes, funiculi and the complete nerve trunk. It additionally distinguishes open and closed nerve injuries. This classification is clinically relevant because the expected recovery and need for surgical assessment differ according to the structural severity of the lesion [8,10,11].

3. Aetiology and Clinical Presentation

The source thesis lists fractures and dislocations, direct laceration, infection including leprosy, compression, traction, friction, thermal injury, cooling and freezing, electrical injury, ischaemia, toxic agents and radiation among the mechanisms of peripheral nerve injury. Radial nerve involvement is discussed in relation to injection injury, tight or prolonged tourniquet application, compression in the axilla from crutch use, proximal humeral fracture or shoulder dislocation, humeral shaft fracture, "Saturday night palsy," surgical procedures, supracondylar or lateral epicondylar fracture, elbow dislocation, radial head fracture, Monteggia fracture and forearm fractures [7,8,10,11].

Clinical features may include pain, paraesthesia, numbness and reduced sensation in the radial nerve distribution. Motor findings range from weakness to paralysis, with reduced wrist and finger extension, flaccidity, muscle wasting and reduced or absent deep tendon reflexes. Autonomic involvement may be associated with changes in skin temperature, colour, texture and sweating. Contracture may develop because of unbalanced muscle pull [4,6,12].

The level of the lesion influences the pattern of deficits. An axillary lesion may affect all radial-nerve-innervated muscles, including triceps, and may reduce the triceps and brachioradialis reflexes. A lesion at the spiral groove may spare triceps while impairing wrist and finger extension and reducing the supinator reflex. A more distal forearm lesion may predominantly affect finger extension and ulnar wrist extension, with no sensory loss in the pattern described by the thesis [5,6,9].

4. Physiotherapy Assessment and Investigations

4.1 Subjective assessment

The subjective assessment described in the thesis records the patient's name, age, sex, occupation, chief complaints, duration and behaviour of symptoms, body chart, past and present history, personal and family history, and associated medical conditions. Smoking, alcohol use, diet and conditions such as diabetes and hypertension are included in the history. The mechanism of injury and the time course of the symptoms are important elements of the history [9,12,14].

4.2 Objective assessment

Observation includes body build, posture, handedness, resting position of the hand, wrist-drop deformity, muscle wasting, swelling, wounds, external appliances, skin and trophic changes, loss of movement and contractures. Palpation is directed to the extensor aspect of the arm, forearm and fingers, with attention to temperature, tenderness, swelling and sensory change.

The examination described in the report includes pain assessment, muscle tone, wrist extensor power, triceps and supinator reflexes, range of motion, muscle bulk, soft-tissue tightness, sensation and functional limitation, particularly gripping. The muscle power grading ranges from grade 0, with no contraction, to grade 5, with full range against maximal resistance. The report describes testing wrist extension with the forearm positioned to first minimize gravity and then against gravity and resistance [3,9,12].

Special tests and procedures listed include the faradic and galvanic response, strength-duration curve, Tinel's sign and radiography when fracture is suspected. Tinel's sign is elicited by percussion along the course of the injured nerve; tingling in the nerve distribution is described as evidence suggestive of progressing axonal regeneration. The report cautions that the sign does not by itself establish the quality of functional recovery [6,9,11].

4.3 Investigations

The diagnostic work-up described in the thesis aims to identify the nerve involved, anatomical level and pathological type of injury, associated bone, vascular or tendon injuries,

secondary deformity or contracture, and evidence of recovery. Investigations include strength-duration curve, nerve conduction studies, electromyography, Tinel's sign, sweat testing, skin resistance testing and electrical stimulation.

The strength-duration curve is presented as a means of distinguishing normally innervated, partially denervated and completely denervated muscle. Nerve conduction studies assess motor and sensory responses, including latency, velocity, amplitude and conduction block. Electromyography is described as helping to identify the presence and extent of denervation and whether reinnervation is occurring. The thesis also describes sweat and skin resistance tests as methods of assessing autonomic involvement [2,6,9].

5. Physiotherapy Management

5.1 Conservative management

The physiotherapy programme in the source report is organized into an early stage and a recovery stage. During the early period, described as up to two or three days, the aims are to prevent oedema, maintain circulation and available range of motion, manage pain, prevent disuse atrophy and initiate muscle re-education. The listed approaches include limb elevation, massage, general limb mobility and faradism under pressure. TENS, interferential therapy and hot packs are listed for pain management. Passive-to-active range-of-motion exercises are recommended for the elbow, wrist and fingers, with particular attention to the wrist and fingers [2,3,9,14].

Electrical stimulation is described as a means of maintaining muscle contractility and delaying disuse or denervation atrophy, with the type of stimulation guided by the electrical findings and the state of innervation. The thesis states that faradic current is used in neuropraxia and that faradic and galvanic currents may be used in axonotmesis. It also notes that the response to stimulation differs in innervated and denervated muscle. These are the approaches as recorded in the source report [2].

During the recovery stage, the aims remain prevention of oedema, maintenance of circulation and range of motion, pain management, muscle re-education and limb protection. Strengthening is introduced when voluntary contraction becomes possible. Functional movements emphasized include elbow extension, wrist extension and finger or thumb extension. The report advises avoiding fatigue of the finger muscles and describes progression according to muscle power:

- For muscle power grades 0–1 and 1–2: electrical stimulation, passive movements, massage and static splinting.
- For grades 2 and 2–3: re-education board, hydrotherapy, active-assisted exercise, free exercise, dynamic splinting and proprioceptive neuromuscular facilitation techniques.
- For grade 3 and above: progressive resisted exercises, springs and pulleys.

The muscles listed for stimulation include triceps, brachioradialis, supinator, extensor carpi radialis, extensor carpi ulnaris, extensor digitorum, extensor digiti minimi, extensor indicis, abductor pollicis and the extensor pollicis muscles [2,3,9].

5.2 Splinting and limb protection

A static wrist cock-up splint is described as maintaining the wrist in approximately 25°–30° of extension. A dynamic splint may be used to assist re-education of weak or paralyzed muscles in coordination with active effort and to protect weak muscles from excessive stretch caused by stronger opposing muscles. The report recommends a wrist and finger extension splint, avoidance of heavy lifting with the involved limb, and education about protecting the hand from secondary injury. Activities that reproduce symptoms, including resisted wrist extension or forearm supination, are to be avoided. Care is also required when handling hot objects if sensation is impaired [3,9,12].

5.3 Exercise and functional re-education

The free-exercise programme described includes sequential finger release, piano-playing movements, wrist extension with the forearm supported, grasping and releasing light objects, tapping the fingers on a table and squeezing a tennis ball. These activities are intended to encourage wrist and finger extension and functional hand use as movement returns. The source also describes use of a re-education board and hydrotherapy for active-assisted movement [3,9,14].

5.4 Physiotherapy in surgical cases

For patients undergoing tendon transfer or other reconstructive procedures, the thesis describes preoperative goals of maximizing passive range of motion, particularly the thumb-index web space and wrist extension, establishing tissue equilibrium, educating the patient about the new muscle-joint relationship, maximizing donor muscle power, maintaining grip strength and assessing possible donor muscles. Preoperative therapy includes active and passive range-of-motion work, strengthening, scar mobility, splinting and sensory monitoring.

Postoperative goals include protecting the transferred tendon, maintaining movement in uninvolved joints, restoring functional range of motion, allowing scar mobility and returning the hand to functional use. The protocol described in the thesis includes immobilization for approximately three to four weeks with the elbow at 90°, forearm pronation, wrist dorsiflexion of 30°–45° and the thumb in abduction and extension. Protective individual-joint movement and scar management are described, while composite flexion is avoided during the initial period. At weeks 3–4, splinting is fabricated according to the surgeon's guidance. At weeks 5–6, brief muscle contractions and education of the transferred muscle are initiated, progressing to light pick-up and release activities. Dynamic flexion splinting may be introduced at week 7 when extrinsic extensor tightness is present; resisted exercise is introduced at week 8, and unrestricted activities are described from week 12 onwards [3,4,8,9].

5.5 Multidisciplinary rehabilitation

The source report emphasizes that rehabilitation should not be limited to the physical impairment. The rehabilitation specialist, physiotherapist, occupational therapist, social worker and vocational counsellor are identified as members of the team. Their roles include supporting the patient and family, explaining the rationale for treatment, encouraging participation and addressing the possible effect of hand disability on employment and social roles [4,12,13].

6. Case Reports

The following case summaries reproduce the clinical information and treatment progress documented in the source thesis. The cases are presented descriptively; no additional measurements or follow-up outcomes have been inferred.

6.1 Case 1: Radial nerve neuropraxia at the spiral groove

A 45-year-old man, employed as a driver, presented with inability to hold the right wrist in position and difficulty grasping objects, accompanied by arm pain. He reported no history of trauma, fracture or leprosy. The disability was noticed on waking after a night of heavy alcohol consumption during which he had slept on a chair. The thesis records the diagnosis as radial nerve neuropraxia at the spiral groove, described as Saturday night palsy.

On examination, wrist drop was present without visible muscle wasting. The patient was right-hand dominant and held the affected hand with the opposite hand. Tenderness was noted over the spiral groove, with diminished sensation over the dorsum of the hand and lateral three and a half fingers. The shoulder range of motion was within normal limits, while movement of the right wrist, fingers and elbow was reduced. Shoulder muscles, elbow and wrist flexors had normal strength; triceps power was grade 3, and elbow and wrist extensors were not assessable. The triceps jerk was present and the supinator jerk diminished. Ambulation, bed mobility and communication were independent, while self-care activities were recorded as dependent.

Treatment on day 1 included individual stimulation of the extensor muscle groups using surged faradic current, triceps strengthening, education about hand care and limb protection, advice to use a static cock-up splint, instruction in sleeping position and self-active movements for the home programme. The same treatment continued from days 2–7, with massage from the elbow downwards. At day 7, the patient demonstrated knowledge of limb protection, exercise and positioning; extensor muscle power was recorded as grade 2 and pain was controlled.

From day 8, the previous programme continued and active-assisted exercises using a re-education board were initiated. The patient was advised to perform a similar exercise programme in water at home. At the end of the following week, extensor muscle power was recorded as grade 3, sensation was near normal, the supinator jerk was present and functional activities had improved markedly. On day 16, electrical stimulation was stopped and the static splint was discarded. The patient declined a dynamic splint for economic reasons and was taught free exercises to continue at home.

6.2 Case 2: Wrist drop following fracture of the proximal radius

A 42-year-old male teacher was referred with left wrist drop following a fracture of the proximal third of the radius. The injury occurred when he slipped and fell on an outstretched hand. He underwent internal fixation and was immobilized in a plaster-of-Paris cast for three weeks. After cast removal, he noticed that he could not move the wrist and initially attributed the disability to immobilization.

Examination showed wrist drop, wasting over the extensor aspect of the forearm, dry skin with absence of hair over the forearm, swelling over the dorsum of the hand and elbow stiffness. Sensation was recorded as normal, warmth was absent and muscle tone was decreased. Shoulder and elbow range of motion on the left was reduced; wrist and hand movements and extensor muscle power were not assessable. The triceps jerk was present and the supinator jerk diminished. Functional activities were recorded as independent. Forearm girth was 9 inches on the left and 10.5 inches on the right; the palm-to-palm test was positive.

On day 1, treatment consisted of passive movements of the elbow, wrist and fingers, mobilization of the left shoulder, advice to use a static cock-up splint, instruction in self-active movements and elevation of the hand to reduce oedema. The same treatment continued through day 7. At the end of that period, shoulder and elbow movements had improved and muscle power was recorded as grade 2. From days 8–15, mobilization of the elbow and superior radioulnar joint, shoulder strengthening and active-assisted exercises were encouraged. The source thesis does not provide a further outcome assessment for this case.

6.3 Case 3: Wrist drop following injection palsy

A 35-year-old woman, a homemaker, was referred with right wrist drop following an injection. She had experienced fever 15 days earlier and developed severe pain and wrist immobility after receiving an injection from a local practitioner. The thesis records no relevant past history, trauma, fracture or leprosy. She had taken painkillers for one week; the pain subsided but the disability remained.

The patient was right-hand dominant. Wrist drop and muscle wasting were present, without trophic changes. She appeared distressed and highly emotional. There was no local warmth. Sensation was diminished over the dorsum of the hand and lateral three and a half fingers, and Tinel's sign was present over the spiral groove. Shoulder range of motion was within normal limits, while wrist and hand range of motion could not be assessed because of the disability. Flexor power was within normal limits and triceps power was grade 3+; other extensors were not assessable. The triceps reflex was intact and the supinator reflex absent. The palm-to-palm test was positive. Ambulation and bed mobility were independent, while self-care activities including cooking, dressing, combing and toileting were dependent.

Treatment on day 1 included surged faradic stimulation to individual muscles, with 30 contractions recorded for each, passive movements of the wrist and fingers, general shoulder mobilization and strengthening, self-active range-of-motion exercises for the elbow, wrist and fingers, advice to use a static cock-up splint and education about limb care, particularly caution when holding hot objects. The programme continued from days 2–7. The patient did not wear the splint despite repeated advice. No remarkable improvement was recorded at day 7, and the patient discontinued therapy attendance.

7. Discussion

The three cases in the source report demonstrate different circumstances associated with wrist drop: sustained external compression at the spiral groove, a presentation following fracture and internal fixation, and an injection-associated presentation. The cases underline the importance of taking a detailed history and examining the distribution of motor and sensory deficits to help identify the likely level and mechanism of nerve injury. In the first case, the diagnosis of neuropraxia at the spiral groove was accompanied by preserved triceps function and triceps reflex, diminished supinator reflex and sensory change over the dorsum of the hand. These findings are consistent with the level-based clinical patterns described in the thesis.

The treatment approaches varied according to the recorded clinical presentation. The first case received individual muscle stimulation, triceps strengthening, splinting advice, education, massage and later active-assisted exercise. Improvement was documented in extensor power, sensation, supinator reflex and functional activities over the reported 16-day period. The second case received passive movement, shoulder mobilization, elevation, splinting advice and later joint mobilization and active-assisted exercise. The report records improvement in shoulder and elbow movement and muscle power to grade 2 by day 7, but does not provide a later outcome. In the third case, stimulation, passive and active movement, shoulder exercise and splint advice were provided; however, splint non-adherence and discontinuation of therapy were documented, with no remarkable improvement at day 7.

These observations should be interpreted as descriptions of individual cases, not as evidence that one intervention is superior to another. The thesis does not provide a standardized outcome scale, a comparison group, a uniform follow-up period or complete follow-up data for all three patients. Therefore, the cases cannot establish treatment efficacy or allow a quantitative comparison of outcomes. The variation in the recorded progress also highlights the relevance of patient education, adherence to splinting and home exercise, and continuity of rehabilitation.

The assessment and management framework in the thesis places emphasis on the full clinical picture: nerve level and injury type, range of motion, muscle power, reflexes, sensation, muscle bulk, pain, skin changes and functional ability. It also links the stage of recovery to the choice of exercise and support. Passive movement and positioning are included when voluntary movement is absent; assisted movement and re-education are introduced as contraction returns; and resisted exercise is progressed when sufficient muscle power is present. Splinting is described as a means of supporting the wrist and fingers and preventing the stronger opposing muscles from overstretching weak extensors. The report further emphasizes the psychosocial and vocational consequences of radial nerve injury. Loss of hand function may affect independence, employment and the patient's expectations of returning to previous activities. A multidisciplinary approach is therefore presented as an essential part of rehabilitation, with patient motivation and cooperation considered important to the rehabilitation process.

8. Conclusion

Wrist drop is a disabling presentation that requires identification of the underlying nerve lesion, its anatomical level and its pathological severity. The source thesis describes a comprehensive physiotherapy approach involving subjective and objective assessment, electrodiagnostic and other investigations, pain and oedema management, maintenance of range of motion, electrical stimulation where indicated, muscle re-education, strengthening, splinting, limb protection and functional exercise. Surgical cases require protection and staged rehabilitation of the transferred tendon, while overall rehabilitation may require physiotherapy, occupational therapy, social work and vocational support.

The three cases illustrate varied clinical presentations and treatment courses. Improvement was recorded in the first case, partial early improvement in the second, and no remarkable improvement with subsequent discontinuation of therapy in the third. These individual observations support the importance of individualized management, patient education, splint adherence and continuity of rehabilitation.

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