Review paper

Post-vaccination orthopaedic complications in the shoulder region: a literature review

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Abstract

Vaccinations, especially related to COVID-19, but also to influenza, have caused the number of vaccination procedures to increase dramatically. An incorrectly selected injection site or incorrect depth of injection into the deltoid muscle area can lead to both complications from the musculoskeletal system due to the vaccination being administered to nearby structures, and a decrease in the effectiveness of the vaccination. Vaccination into the deltoid muscle area may be accompanied by orthopaedic complications; they are rare, although the number of these complications increases with the number of vaccinated patients. A review of the literature on orthopaedic complications after vaccination was conducted, dividing them into two groups – shoulder injury after vaccination and damage to the axillary nerve.

Introduction

Mass vaccinations, particularly those associated with COVID-19 and influenza, have significantly increased vaccination procedures globally. According to the World Health Organisation (WHO) and the U.S. Advisory Committee on Immunization Practices (ACIP), intramuscular vaccine administration in children over 3 years of age and adults should be performed in the deltoid muscle, approximately 2–3 fingerbreadths below the acromion process of the scapula [1]. The majority of COVID-19 vaccinations were administered to the deltoid region. The unprecedented demand for vaccination services during the pandemic necessitated the involvement of personnel with limited injection experience, potentially leading to administration errors. A proper intramuscular injection technique is essential for vaccine delivery to adequately vascularised areas. Suboptimal needle placement or inappropriate insertion depth in the deltoid muscle region may result in musculoskeletal complications due to unintentional injection into adjacent anatomical structures, including nerves, bursal spaces, and tendons. Furthermore, administration into poorly vascularised tissue may compromise vaccine efficacy [2].

Due to the substantial volume of administered vaccinations, which is projected to remain elevated in subsequent years, physicians and orthopaedists should incorporate recent vaccination history into their diagnostic assessment of patients presenting with shoulder pain, as vaccine administration may be an underlying aetiology of the reported pain.

Methods of literature search

A literature review was conducted using the following electronic databases: PubMed/Medline, Scopus, Web of Science, and Google Scholar. The search was limited to English-language publications from 2010 to 2025, with a particular focus on the period after 2020, following the start of mass COVID-19 vaccination campaigns.

The following keywords and their combinations were used in the search: "SIRVA", "shoulder injury after vaccination", "vaccine complications", "deltoid injection complications", "axillary nerve injury", and "brachial neuritis vaccination". Review articles, case reports, and original research studies were included.

Eligible publications addressed orthopaedic complications associated with intramuscular vaccine administration into the deltoid region, focusing on mechanisms, incidence, and treatment options. Due to the heterogeneity and limited number of original studies, a narrative review approach was adopted (Table 1).

Development of the subject matter

Orthopaedic complications following deltoid muscle vaccination administration remain relatively uncommon; however, their incidence increases as the number of vaccinated patients expands. Wright *et al.* [3] categorise these complications into three categories: (I) local inflammatory reaction (SIRVA), (II) brachial plexus neuritis, and (III) direct nerve injury.

Table 1. Summary of selected publications on post-vaccination shoulder complications

Author (year)	Type of publication	Data/no. of cases	Type of complication	Vaccine	Key findings
Atanasoff *et al.* (2010)	Case series	13 cases	SIRVA	Influenza	First formal description of SIRVA as post-vaccination shoulder dysfunction.
Bass and Poland (2022)	Narrative review	305 cases (VAERS, USA)	SIRVA	COVID-19	Most symptoms occur within 48 h; female predominance (76%).
MacKenzie (2017)/2022/2023	Retrospective analysis	1220 cases	SIRVA	Various	Underreporting suspected; pain and limited ROM most common.
Wright *et al.* (2023)	Systematic review	–	SIRVA, nerve injury	Various	Classification: inflammatory (SIRVA), autoimmune neuritis, and direct injury.
Yuen *et al.* (2022)	Case report + review	1 case	Subacromial bursitis (SIRVA)	mRNA COVID-19	Symptoms began within 1 day; MRI confirmed/confirmed by MRI; treated successfully conservatively.
Choi *et al.* (2001)	Case report	1 case	Axillary nerve injury	Not specified	Caused by improper injection depth into the deltoid muscle.
Laulan (2019)	Literature review	–	Radial nerve palsy	Not specified	Describes “wrist drop” following high radial nerve injury due to injection.
Nakajima *et al.* (2017)	Anatomical (cadaver) study	20 cadavers	–	–	Proposes a safer deltoid IM injection site based on anatomical measurements.

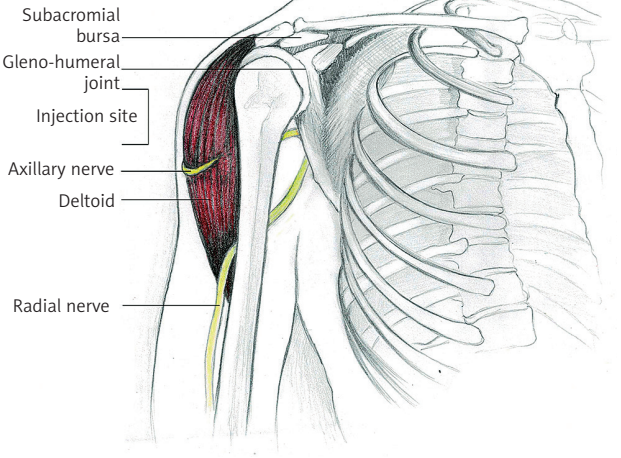

Figure 1. Anatomical trajectory of the axillary and radial nerves

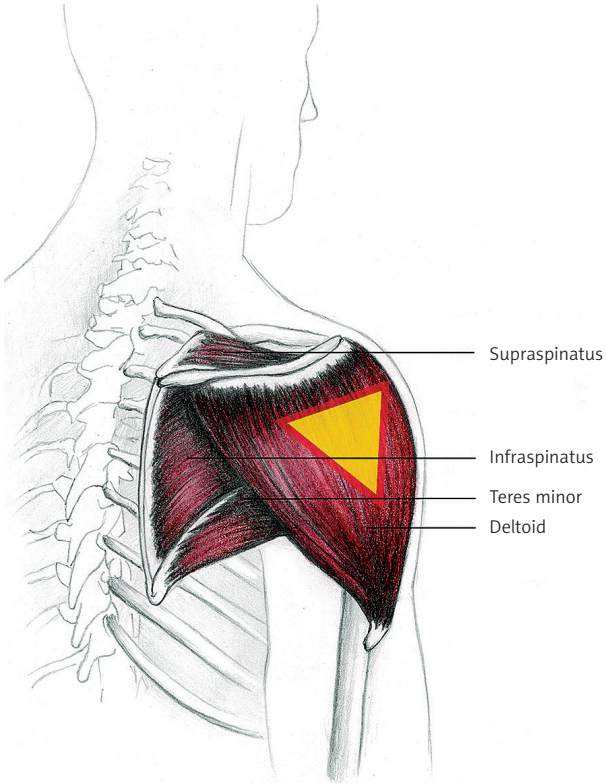

Figure 2. Location of the safe injection site in the deltoid muscle area (triangle)

SIRVA (Shoulder Injury Related to Vaccine Administration)

SIRVA (Shoulder Injury Related to Vaccine Administration) is a broad term encompassing atypical shoulder pain and dysfunction post-vaccination, associated with mechanical, chemical, or immunological injury to structures in the shoulder area. SIRVA was first characterised by Atanasoff *et al*. in 2010 [4] as a pain and should dysfunction post-vaccination occurring in patients with no previous history of shoulder joint pathology. According to the Vaccine Adverse Event Reporting System (VAERS), 305 cases of SIRVA were reported as a post-COVID-19 vaccination complication in the United States. MacKenzie *et al*. [5] documented 1,220 SIRVA cases between 2010 and 2017. Both authors agree that the reported cases underrepresented the actual incidence of complications [4, 5]. The mean age of patients with SIRVA is 51.8 years (range: 19–90), with a female predominance of 76.3% versus 23.7% of male patients [2].

The predominant clinical manifestations in SIRVA patients include pain (97.7% of cases) and restricted shoulder mobility (68.1% of cases) [2]. Less frequent presentations include stiffness, sensory disturbances, and muscle weakness. Most symptoms occur within 48 hours post-vaccination; however in cases of adhesive capsulitis, symptoms may be delayed, manifesting within 1 month (approximately 65% of cases), or more than 3 months (approximately 25% of cases). The primary cause of SIRVA is incorrect needle penetration into one of the bursal structures around the shoulder, which may result in inflammation of the subacromial bursa, subdeltoid bursa, or subcutaneous shoulder bursa as well as adhesive capsulitis. Less common causes of SIRVA include rotator cuff injury, damage to the articular cartilage of the shoulder joint, septic or pseudo-septic arthritis, or even lytic erosion of the humeral head [6–9].

Nearly 75% of patients diagnosed with SIRVA are female [3]. This is explained by anatomical differences. In women, the subdeltoid bursa is located 0.8–1.6 cm below the cutaneous surface, a depth readily accessible with a standard 25 mm needle. Women typically present with reduced muscle mass and increased subcutaneous adipose tissue in this region compared to men, which increases their risk of complications.

Location and depth of injection should always be tailored to the individual patient, considering gender, age, and body weight. A proper vaccine administration technique is crucial for avoiding SIRVA. An injection administered “too high” may reach the subacromial bursa, while the one administered “too low” may hit the radial nerve, and the one administered too laterally may damage the axillary nerve [10–12].

SIRVA management encompasses a broad range of therapies, including anti-inflammatory drugs (NSAIDs), to physical therapy, corticosteroids (oral or intravenous), and in some cases, surgical intervention [3, 6]. The majority of patients demonstrate improvement with physical therapy and anti-inflammatory drugs, including corticosteroids. Surgery is rarely indicated, though certain cases of adhesive capsulitis require arthroscopy, and purulent arthritis may also require intervention [3, 9].

Brachial Plexus Neuritis

Brachial Plexus Neuritis**,** also known as amyotrophic neuralgia or Parsonage-Turner syndrome, is a rare vaccination complication caused by an autoimmune response, occurring more frequently after viral infections than following vaccination [3].

Symptoms typically appear between day 3 and week 3 post-vaccination and include varying degrees of muscle weakness in different locations. Sensory disturbances in the upper limb may also occur. In some cases, both brachial plexuses may be affected.

Diagnosis is confirmed by electromyography (EMG) and/or nerve conduction studies (NCS), which usually show nerve damage, though damage to the plexus may also occur with normal EMG/NCS results. Treatment is always conservative, ranging from observation to oral or intravenous corticosteroids. Most patients improve within a few weeks, but partial weakness may persist for more than 2 years.

Direct Nerve Injury

Direct Nerve Injury: the literature documents cases of direct nerve injury following vaccination, primarily affecting the axillary or radial nerves [3].

Nerve injury symptoms appear within 24 hours post-vaccination, facilitating differentiation from autoimmune-induced damage (which manifests between day 3 and week 3). Symptoms include progressive weakness in muscles innervated by the damaged nerve [3].

The axillary nerve [13–16] is located about 4–7 cm below the acromion in the deltoid muscle area and travels horizontally around the surgical neck of the humerus [17, 18].

The main symptom of axillary nerve damage is the lack of contraction in the deltoid muscle and an inability to actively abduct the arm, which can be partially compensated by other muscles. Additionally, there is superficial sensory disturbance in the area innervated by the lateral cutaneous nerve of the arm, a branch of the axillary nerve, on the posterior-lateral surface of the arm [15, 19]. Prolonged axillary nerve damage may lead to gradual atrophy of the deltoid muscle [20].

Radial nerve injury manifests as weakness or inability to extend the fingers, or hand, and impaired thumb abduction. Sensory disturbances affect the posterior surface of the forearm and the dorsal surface

of fingers I, II, and the radial side of finger III. This condition is referred to as "drop hand" [9].

The radial nerve [21] runs behind the brachial artery in the axillary area and travels between the long and medial heads of the triceps muscle.

Diagnosis is confirmed by EMG/NCS, which shows varying degrees of nerve damage. Magnetic resonance imaging (MRI) may reveal oedema along the nerve course, though this is not essential for diagnosis.

Conservative treatment includes rehabilitation with physical therapy and local steroid administration. Full nerve function recovery may extend from several weeks to several months, and complete symptom resolution is not always achieved [22]. Surgical intervention is rarely required, typically limited to nerve neurolysis [3].

Conclusions

Prolonged pain and dysfunction in the shoulder joint post-vaccination is an uncommon complication. These cases can be put into three categories: (I) local inflammatory reaction (SIRVA), (II) dysfunction of the brachial plexus caused by an immune response, and (III) direct nerve injury. Most cases of local inflammatory reactions can be successfully treated conservatively, and advanced imaging techniques do not alter the treatment course in patients presenting with symptoms within 3 months post-vaccination. For patients with neurological symptoms, EMG/NCS can be performed. In cases where symptom onset occurs beyond 3 weeks, immunological brachial plexus neuritis should be considered, whereas in those who develop symptoms rapidly, a direct nerve injury is suspected. Current literature does not provide a definitive treatment protocol for these complications but suggests that rehabilitation and corticosteroids are beneficial.

Patients who are hesitant to vaccinate due to concerns regarding arm dysfunction can be reassured that the benefits of vaccination outweigh the risk of complications, as they are rare and most resolve with conservative treatment.

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Conflict of interest

The authors declare no conflict of interest.

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