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Pathokinesiological Discussion on Abduction Contracture of the Shoulder Joint Secondary to Partial Rupture of the Deltoid Muscle

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A 43-year-old female patient, seen at Ishikawa Hospital in 1990, had abduction contracture of the shoulder due to rupture of the middle portion of the deltoid muscle, on which surgical repair was not performed. Abduction contracture of the shoulder had been reported in children. However, these emphasized mainly surgical treatment and seemed to pay little attention to disabilities from the standpoint of pathokinesiology. In this paper we attempted to elucidate the pathogenesis and disabilities as well as the mechanism of winging of the scapula as it appears in a patient with abduction contracture of the shoulder joint from the kinesiological point of view.

Key Words
Abduction contracture of the shoulder,
Rupture,
Deltoid muscle,
Winging of the scapula,
Pathokinesiology.

INTRODUCTION

Limitation of motion of the shoulder due to fibrous contracture of the deltoid has been reported in the last few decades (1–4). However, there have been only rare reports of contracture affecting the deltoid secondary to its rupture on which surgical repair was not performed. Recently, we observed a female patient who had abduction contracture of the glenohumeral joint with tightness and atrophy of the middle fiber of the deltoid muscle following its partial rupture. When the patient tried to lower her arm to her side, remarkable winging of the scapula was also observed. This winging occurred to compensate for the restriction of movement of the glenohumeral joint by scapular motion. The purpose of this study is to describe this patient and to discuss the kinesiological mechanism of her disabilities as well as the occurrence of the winging of scapula.

CASE REPORT

A 43-year-old female visited our hospital on March 24, 1990 because of right shoulder pain and restriction of shoulder motion. For one month prior to the first examination in our hospital, she had right shoulder and arm pain and progressive inability to lower her right arm to her side. More recently she experienced right shoulder and arm pain, and the pain was described as severe and steady, and required some anodynes and poultice for

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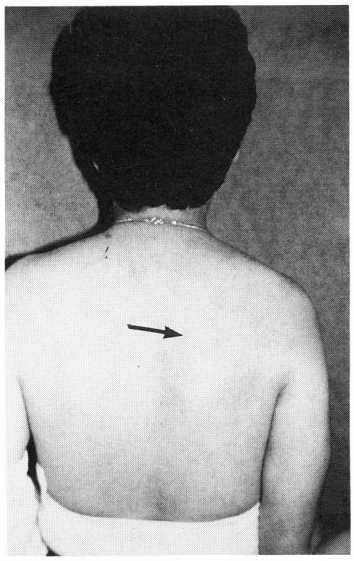

Figure 1. Winging of the right scapula appearing when the patient attempts to adduct the arm.

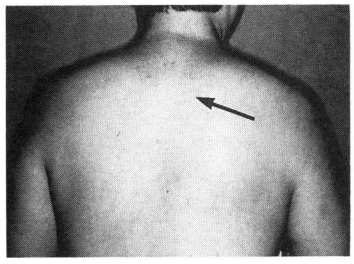

Figure 2. Muscle tenderness over the right rhomboid muscle.

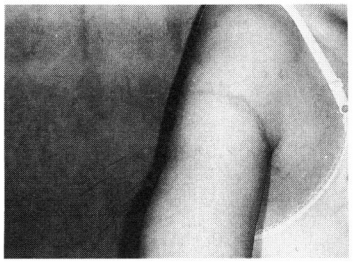

Figure 3. Localized spotty pigmentation, a vertical depression and cord-like structure of the right arm.

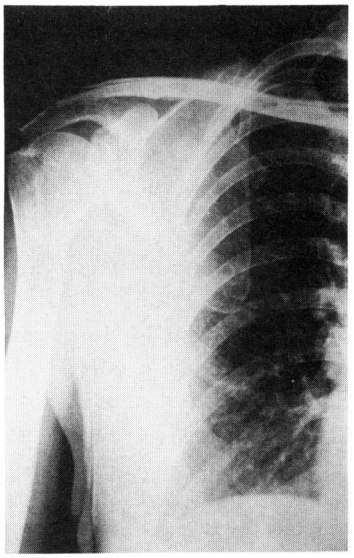

Figure 4. Anteroposterior radiograph of the right shoulder, showing downward rotation of the scapula when the arm at the side.

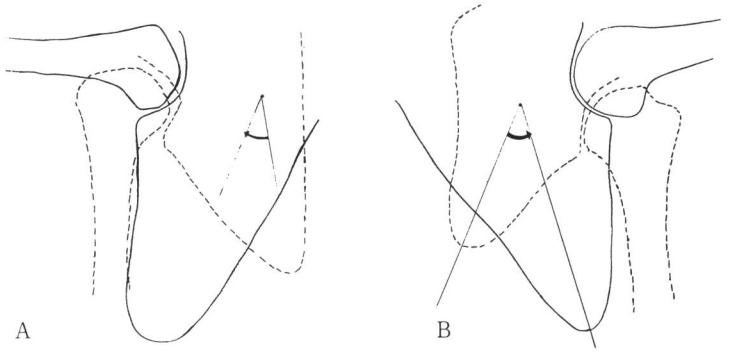

Figure 5. Diagrams of glenohumeral and scapulothoracic joints at both shoulders, showing the difference of scapulohumeral rhythm. (A) left shoulder, (B) right shoulder from behind.

relief.

She had been healthy until February 27, 1990. Then, while she was working in a factory, her jacket was caught in a cogwheel, causing her right arm and body to bind tightly as if twisting a cord around her arm and at first she was diagnosed as a simple contusion of the right arm and her arm was immobilized in 90° abduction with a plaser cast for three weeks in a nearby hospital.

However, by detailed examination in our hospital, it was revealed that her disability was due to rupture of the middle fiber of the right deltoid muscle.

On physical examination the patient had full cervical motion but 30° abduction contracture of the right shoulder. There was also winging of the right scapula when she attempted to adduct the arm and the inferior angle of scapula was elevated and rotated medially, that is, downward rotation of the scapula occurred (Fig. 1). Over the middle part of the deltoid muscle, a vertical depression and cord-like structure was palpable. There was also tenderness over the right rhomboid muscle (Fig. 2). No neuromuscular deficit was noted over the neck, shoulder and arm, but localized circular pigmentation of the skin was noted over the lateral side of the right arm (Fig. 3). The range of motion for passive flexion was over 150 degrees and 160 degrees for passive abduction. Active ranges of motion for flexion and abduction were 130 and 140 degrees respectively. As for internal and external rotation, the ranges of motions were 60 and 70 degrees respectively. The result of a manual muscle test was that all the muscles around the right shoulders, except for grade 3 in the middle fiber of the deltoid, were grade 4～5. Her use of the shoulder was moderately restricted to activities such as combing her hair and brushing her teeth.

Radiographical study identified no osseous abnormality except for the downward rotation of the scapula (Fig. 4). Cineradiography confirmed that adduction from the abducted position of 30° took place mainly at the scapulothoracic joint and scapulohumeral rhythm differed from that of the sound side (Fig. 5).

In spite of frequent attempts of persuasion by the orthopedic surgeon in our hospital, she refused to have an operation to repair the ruptured deltoid muscle. Hence, conservative treatment was performed to restore muscle strength and range of motion of the shoulder by physical therapy.

DISCUSSION

1. The Pathogenesis of Abduction Contracture of the Shoulder

A search of the literature has failed to discover a similar case, although there are reports of patients with abduction contracture of the glenohumeral joint (1–4).

Several possible etiological factors have been suggested as the cause of fibrosis of the deltoid muscle as well as quadriceps. Among these are genetic (5) and congenital (6) factors and postnatal disease. The postnatal factor that has received most emphasis is intramuscular injections (7–10). Sato, Honda and Inoue (11) and Bhattacharyya (1) each described three patients in whom the case was a contracture of the middle portion of the deltoid. A similar condition occuring in the quadriceps muscle has been reported by Gunn (8), Karlen (12), Lloyd–Roberts et al (13) and Williams (10) over the last few decades. All cases caused by intramuscular injection occurred in children and young adults, and appeared to be slowly progressive until treated.

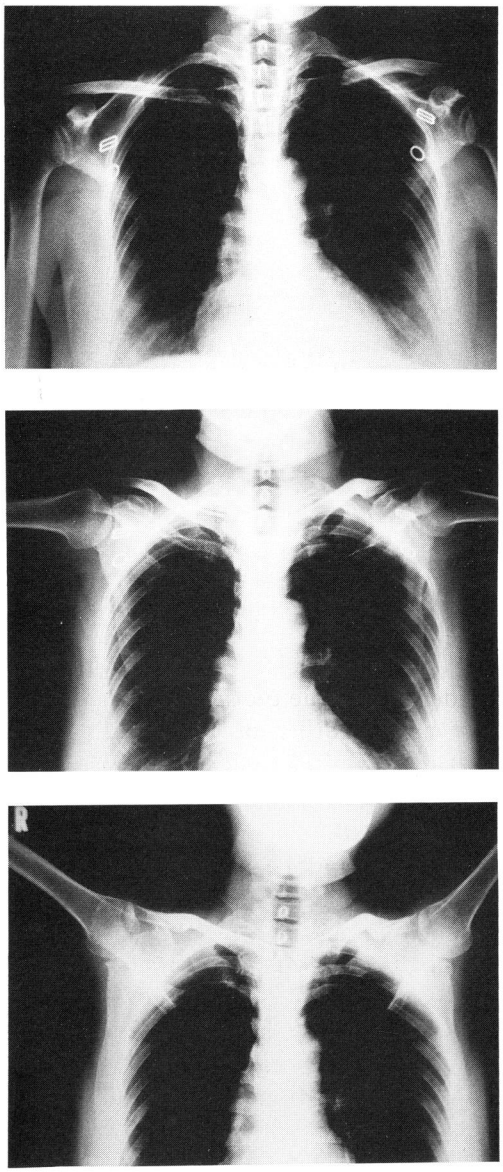

Figure 6. Anteroposterior radiographs of the both arms, showing sequential changes of the bones at (A) the arms in the resting position, (B) elevation of the arms to 90°, and (C) elevation of the arms above the head.

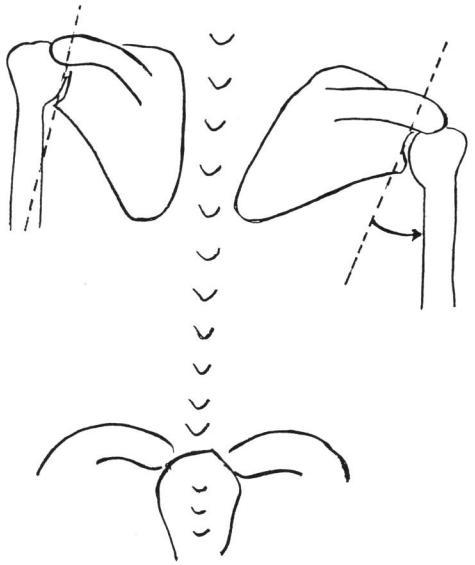

Figure 7. Diagram showing the relationship between the humerus and scapula if the latter rotated downward, causing susceptibility of subluxation at the glenohumeral joint (cited from Anderson LT: Shoulder pain in hemiplegia. Amer J Occup Therap 39: 10–19, 1985)

There seems no doubt that the contracture in our patient was caused by the immobilization for a long time following partial rupture of the middle portion of the deltoid muscle, with fibous tightness of the remainder part of it, by injury, though the pathogenesis was different from that of intramuscular injection. The clinical features, however, consist of the abduction contracture at the glenohumeral joint and winging of the scapula and these are exactly same as the cases mentioned above (1, 2, 14–16, 17). Why was only the middle part of the deltoid affected by injury? It is suggested that the middle portion of the deltoid, having an anatomical structure different from that of the anterior and posterior portions, is either

fibrous at birth of gradually undergoes fibrosis after birth (1): the anterior and posterior portions are comprised of long fibers which converge slightly as they course toward their aponeurotic tendinous insertions into the humerum. The middle portion, in contrast, is multipenniform, and several tendinous expansions descend into the muscle from the acromion and others ascend into it from the tendon of insertion. Hence, the middle portion normally contains more connective tissue than the remainder of the deltoid (18). This is the reason why the middle portion of the deltoid is particularly contracted.

2. Pathokinesiology for Abduction Contracture of the Shoulder

In the present case, the scapulohumeral rhythm of the right shoulder showed abnormality in comparison with that of the sound side. Normally to achieve full forward or sideward elevation of the shoulder during passive or active motion, upward rotation of the scapula is indispensable in addition to the movement at the glenohumeral joint. This is explained using the concept of scapulohumeral rhythm, which states that for every 15° of elevation of the arm, 5° results from movement of the scapula rotatiog upwards and 10° results from movement at the glenohumeral joint (19). It is a two-to-one ratio: in full 180° of elevation of the arm, 120° of that movement is at the glenohumeral joint, and 60° is from upward rotation of the scapula. If the movement at the glenohumeral joint is impeded, elevation of the arm can be achieved by only scapular upward rotation (20). Figure 5 shows positions of bones of the shoulder as seen in radiographs of (A) the arm in the resting position, (B) elevation of the arm to 90°, and (C) elevation of the arm above the head. These radiographs reveal how the scapulohumeral rhythm of the involved side (right shoulder) differs from that of the sound side (left shoulder) (Fig. 6).

Our patient appeared with winging of the scapula. Most other reports also mention this deformity as an associated finding (14, 16, 17) and radiographical examinations reveal restriction of the adduction at the glenohumeral joint is compensated by upward displacement and rotation of the scapula until that can go no farther and the abduction deformity does not become obvious. Once the scapula rotates downward, its superior angle displaces laterally, causing winged scapula as well as stretching of the muscles such as the rhomboid muscles, attached to medial border of the scapula. This causes tension of rhomboid muscles. That is the reason why the patient felt tenderness in the thoracodorsal area over the medial border of the scapula.

If the scapula is rotated downward, the humerus is also essentially abducted in relation to the scapula (Fig. 7), and thus is susceptible to subluxation at the glenohumeral joint. This instability of the glenohumeral joint caused by abduction contracture was pointed out by Bhattacharyya (1) and Anderson (21).

In summary, when limitation of motion at the glenohumeral joint in the coronal plane exists, one should give careful consideration to the shoulder girdle including the scapulothoracic joint because scapular rotation at the scapulothoracic joint would compensate for lack of mobility at the glenohumeral joint. This is a key mechanism explaining why the winging of the scapula and tenderness appear in the patient with abduction contracture of the shoulder secondary to fibrous replacement of the deltoid muscle following its rupture.

REFERENCES

1. Bhattacharyya S: Abduction contracture of the shoulder from contracture of the intermediate part of the deltoid. Report of three cases. J Bone Joint Surg 48–B: 127–131, 1966
2. Goodfellow JW and Sydney N: Flexion contracture of the shoulder joint from fibrosis of the anterior part of the deltoid muscle. J Bone Joint Surg, 51–B: 356–358, 1969
3. Hill N, Liebler WA, Wilson HJ, et al: Abduction contractures of both glenohumeral joints and extension contracture of one knee secondary to partial muscle fibrosis. A case report. J Bone Joint Surg 49–A: 961–964, 1967
4. Roldan F and Warren D: Abduction deformily of the shoulder secondary to fibrosis of the central portion of the deltoid muscle. In Proceedings of the American Academy of Orthopedic Surgeons. J Bone Joint Surg 54–A: 1332, 1972
5. Fairbank T and Barret AM: Vastus intermedius contracture in ealy chidhood. Case report in identical twins. J Bone Joint Surg 43–B: 326–334, 1961
6. Hnevkovsky O: Progreesive fibrosis of the vastus intermedius muscle in chidren. A cause of limited flexion and elevation of the patella. J Bone Joint Surg 43–B: 318–325, 1961
7. Branick RL, Roberts JL, Glynn JJ, et al: Talwin induced Deltoid contractures. In proceedings of the Western Orthopedic Association J Bone Joint Surg 58–A: 279, 1976
8. Gunn DR: Contracture of the quadriceps muscle. A discussion on the etiology and relationship to recurrent dislocation of the patella. J Bone Joint Surg 46–B: 492–497, 1964
9. Hang Ys and Miller JW: Abduction contracture of the shoulder. A Report of two patients. Acta Orthop Scandinavia 49: 154–157, 1978
10. Williams AK: Quadriceps contracture. J Bone Joint Surg 57–B: 463–465, 1975
11. Sato M, Honda S and Inoue H: Three cases of abduction contracture of the shoulder joint caused by fibrosis of the deltoid muscle. Orhtop Surg 16: 1052–1056, 1965 (In Japanese)
12. Karlen A: Congenital fibrosis of the vastus intermedius muscle. J Bone Joint Surg 46–B: 488–502, 1964
13. Lloyd–Roberts J and Thomas TG: The etiology of quadriceps contracture in children. J Bone Joint Surg 46–B: 498–502, 1964
14. Groves RJ and Goldner JL: Contracture of the deltoid muscle in the adult after intramuscular injections. J Bone Joint Surg 56–A: 817–820, 1974
15. Wolbrink AJ, Hsu Zutzang and Bianco AJ: Abduction contracture of the shoulders and hips secondary to fibrous bands. J Bone Joint Surg 55–A: 844–846, 1973
16. Nakatani M. kumon Y and Fujiwara M: Congenital contracture of the deltoid muscles. Orthop. Surg 22: 815–818, 1971 (In Japanese)
17. Konkel KF and Lucas GL: Abduction Contracture of the shoulders. Clin Orthop Relat Res 104: 224–227, 1974
18. Morris' Human Anatomy, eleven edition. JP Schaeffler (ed). New York The Blakiston Co 1953, p. 450–451
19. Codman EA: The Shoulder. Thomas Todd Co Boston, 1934
20. Magee DJ: Orthopedic Physical Assessment. W. B. Saunders Co 1987 p. 62–91
21. Anderson LT: Shoulder pain in hemiplegia. Amer J Occup Therap 39: 10–19, 1985
22. Shen YS: Abduction contracture of the hip in children. J Bone Joint Surg 57–B: 463–465, 1975
23. De Valderrama JAF: A cause of limited flexion and adduction of the hip in children. In proceedings of the British Orthopedic Association. J Bone Joint Surg 52–B: 179, 1970
24. Peiro A, Fernadez CI and Gomar F: Gluteal fibrosis. J Bone Joint Surg 57–A: 987–990, 1975
25. Hang YS: Contracture of the hip secondary to fibrosis of the gluteus maximus muscle. J Bone Joint Surg 61–A: 52–55, 1979