

석회화 건염 Calcific Tendinitis of the Shoulder

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Calcifying tendinitis of the rotator cuff is a common disorder of unknown etiology in which reactive calcification usually undergoes spontaneous resorption in the course of time with subsequent healing of the tendon.

Historical review

Duplay (1872): scapulohumeral periarthritis, Duplay's disease

Painter(1907), Stieda and colleagues (1908): the first to demonstrate radiologic appearance of the disease

Codman (1934): "The deposits do not arise in the bursa itself, but in the tendons beneath it"

"degeneration of tendon fibers preceded calcification"

Wrede (1912): "The cells resemble more and more chondrocytes, meanwhile the fibre arrangement of the tendon is lost"

Bosworth (1941): 2.7% incidence in 6,061 employees

Bateman (1978): Deposits at the site of tendon attachment were in a "zone of stress" and an area of hypovascularity.

Uhthoff and Loehr (1997): Progressive reactive calcification process to describe the disease cycle

Harrington and Codman (1902): The first reported operative removal of a calcific deposit

Nomenclatures:

peritendinitis calcarea, periarthropathy, calcified peritendinitis,
calcific or calcified tendinitis, calcifying tendinitis

Anatomy

"Critical portion" (Codman, 1934), Critical zone (Moseley and Goldie, 1963):
About half an inch proximal to the insertion

The vascularity of the cuff tendon:

Moseley and Goldie (1963)

Rothman and Parke (1965)

Brooks and associates (1992)

Rathbun and Macnab (1993): The avascularity was dependent on the position of the arm.

Tillmann (1992)

Incidence

Normal population

Bosworth (1941): 16% of 6061 office workers

Welfling and colleagues (1965): 7.5%(15/200)

Ruttimann (1959): 20%(100 individuals)

DePalma (1961): 10% of population / 10% bilateral deposits

Painful shoulders

Welfling and colleagues (1965): 6.8%(925)

—— 19.5% between 31 to 40 years

—— The peak at this age did not correspond with the peak seen in pts. with RCT.

—— Both disease represent different entities.

Friedman (1957): 75/228 pts. —54/75 between 30 to 49 years of age.

Bosworth (1941): 35 to 45% of pts. with calcareous deposits will eventually become symptomatic.

Jim and Hsu (1993): 25% coexistence of calcific tendonitis & RCT (arthrographic study)

Location

Plenk (1952): 82% of the calcifications——supraspinatus tendon.

Bosworth (1941): 90% in the supraspinatus and infraspinatus

51% in the supraspinatus

44.5% in the infraspinatus

23.3% in the teres minor

3% in the subscapularis

Depalma and Kruper (1961): 74% when assessing the supraspinatus alone 90% in the supraspinatus and other short rotators

Sex ratio

In general, women are affected more often than are men.
It seems that men peak slightly later than do women.

Classification

Bosworth: according to their size and corresponding clinical significance

- 1) small (up to 0.5 mm) — little clinical significance
- 2) medium (0.5 to 1.5 mm)
- 3) large (>1.5 mm)

DePalma: acute, subacute, chronic

Patte and Goutallier (Rev Chir Orthop 74:277-278, 1988):

Localized form

- 1) round or oval, dense, and homogeneous and lies close to the bursal wall
- 2) It tends to heal spontaneously.

Diffuse form

- 1) situated much deeper in the tendon, close to the bony insertion, and has radiologically a heterogeneous appearance.
- 2) produces more symptoms and takes longer to disappear.

Dystrophic calcification associated with a tear indicates a poor Px. and progressive degenerative changes and is not comparable with the spontaneous healing of the tendon in calcifying tendinitis. Moreover, dystrophic calcifications do not occur in mid-tendon but arise much closer to the bony insertion.

Pathology

The calcific deposits appear multifocal, separated by fibrocollagenous tissue or fibrocartilage.

chondrocyte-like cells

Calcium granuloma

Pathogenesis

two causative factors

- 1) circumscribed tissue hypoxia
- 2) localized pressure

Causes of pain

- 1) An inflammatory-induced response to the local chemical pathological disorder

2) response to direct mechanical irritation

Neer describes four types of pain associated with calcium deposits

- 1) the calcium's ability to irritate the tissue chemically
- 2) pressure within the tissue as it swells.
- 3) An impingement-like pain caused by bursal thickening and irritation and occasionally by deposit prominence.
- 4) Chronic stiffening of the glenohumeral joint ("frozen shoulder")

Physical characteristics

Water(H₂O), carbonate(CO₃), Phosphate(PO₄), basic calcium phosphate crystals

Rowe (1985): three forms

- 1) dry, powdery deposit
- 2) soft putty, or toothpaste deposit: mild chronic pain
- 3) milky or creamy collection: acute painful phase

Degenerative Calcification

1) wear and tear effect

& ——— Degeneration of the fiber ——— Dystrophic
aging of rotator cuff calcification

2) In general, supporters of the theory of degenerative calcification fail to take into consideration of affected persons, the course of the disease, and the morphologic aspects of calcific tendinopathy. The incidence of calcification increases with age in cases of degenerative calcification, whereas it peaks during the fifth decade in cases of calcifying tendinitis. Moreover, degenerative diseases never exhibit a potential for self-healing. Furthermore, the histologic and ultrastructural features of degenerative calcification and calcifying tendinosis are quite different.

Reactive Calcification

Uthoff proposed that evolution of the disease can be divided into three distinct stages: precalcific, calcific, postcalcific

<u>Precalcific</u>	<u>Calcific</u>	<u>Postcalcific</u>
(-) pain	Formative, Resting, Resorptive (±) pain (±) pain	(+)pain (±) pain

- 1) **Precalcific Stage**: fibrocartilaginous transformation
 ——Metaplasia of tenocytes into chondrocytes
- 2) **Calcific Stage**
- A) **Formative Phase** (“Early phase of Increment” of Lippmann)
- Calcium crystals are deposited primarily in matrix vesicles, which coalesce to form large foci of calcification.
 - Chalk-like consistency
- B) **Resting Phase**
- Fibrocollagenous tissue borders the foci of calcification.
 - termination of deposition
- C) **Resorptive Phase** (“Late phase of Increment” of Lippmann)
- Appearance of thin-walled vascular channels at the periphery of the deposit.
 - A thick, creamy or tooth-paste-like material
- 3) **Postcalcific stage**
- New vascular channels promote fibroblasts to form type III collagen that becomes replaced by type I collagen.
- # It is difficult to establish what triggers the fibrocartilaginous transformation in the first place.
- Codman: tissue hypoxia
 - Sengar, McKendry, Uhthoff (1987): HLA-A1: genetically susceptible to the condition.

Radiologic Evaluation

- Painter (1907): first identified calcifications in the periarticular soft tissue of the shoulder.
- AP views with the shoulder in the N/R, I/R and E/R, axillary lateral view
- Supraspinatus outlet view
- CT: acute or resorptive phase
- MR Imaging: On T1-weighted images, calcifications appear as areas of decreased signal intensity. T2-weighted images frequently shows a perifocal band of increased signal intensity compatible with edema.

- Arthrograms

Two radiographic types (DePalma and Kruper, CORR 20:61-72, 1961)

Type I: 1) has a fluffy, fleecy appearance, with a poorly defined periphery.

2) It is usually encountered in patients with acute pain.

3) An overlying crescentic streak indicates rupture of the deposit into the bursa, which occurs only in this type.

Type II: 1) discrete, homogeneous deposits with uniform density and a well-defined periphery.

2) This type is seen in subacute and chronic cases.

1) The formative phase

: When pain is chronic or even absent, the deposit is dense, well defined, and homogenous.

2) The resorptive phase

: · Acute pain

· The deposit is fluffy, cloud-like, ill-defined, and irregular in density

· Rupture of the calcific deposit into the bursa can occur only during the resorptive phase, because of the toothpastelike or creamy consistency.

· Radiographs show a crescentic radiodensity overlying the deposit.
well-delineated deposit → a fluffy, ill-defined deposit

Most authors agree that radiographic evidence of degenerative joint disease is usually lacking in patients with calcific tendinopathies.

- Sonography:

Hartig and Huth (1995): more sensitive than radiography (100%, 90%)

— more exact localization of the deposit without subjecting the pt. to radiation

Management

- Distinguishing between the formative phase and the resorptive phase is important for proper management.

Nonoperative treatment

To avoid loss of mobility of the glenohumeral joint and keep the arm in

abduction as much as possible.

- # Nonsteroidal anti-inflammatory drugs
- # Therapeutic ultrasound (Robertson, Baker 2001; Ebenbichler, Erdogmus, Resch 1999)
- # Intrabursal injection of corticosteroids
- # Needle lavage
 - Acutely painful shoulder in the resorptive phase
 - Lavage of the deposit with the use of two large-bore needles and 2% lidocaine
 - Even when the lavage is negative, the multiple perforations of the site of deposition will decrease the intratendinous pressure and thus the pain.
 - Patterson & Darrach 1937
 - Comfort & Arafiles 1978
 - Ultrasound-guided needle puncture (Aina 2001, Farin 1996): 70% favorable results

Extracorporeal Shock-Wave Therapy (ESWT)

- # Lithotripsy in urology, still under investigation
- # Rompe et al (CORR 321, 196-201, 1995):
 - In 25 pts. a partial or complete disappearance of the calcific deposit
- # Loew et al (J Shoulder Elbow Surg 4, 101-106, 1995) :
 - 1) 14/20 pts. experienced symptomatic improvement at the time of F/U 12 wks. after the procedure.
 - 2) Local hematomas developed in 14 patients after this therapy.
 - 3) 30% of the pts. had an improvement of the Constant-Murley score.
 - 4) In 7 pts, the deposit had disappeared completely.
- # Loew (1999)
 - Energy-dependent success, with relief of pain ranging from 5% in the control group to 58% after two high-energy sessions.
- # Daeckes (2002)
 - 115, prospective study, 4 yr F/U,
 - Energy-dependent success, 20% of the entire patient had undergone surgery

Surgical Indications

- # 10% (Rochwerger 1999)
- # Should conservative therapy fail during the formative phase, surgery may

- become necessary. During the resorptive phase, when natural mechanism usually succeed in removing the deposit, surgery is very rarely indicated.
- # Harrington and Codman (1902): the first operative procedure for removal of deposit.
 - # Three indications (Gschwend et al, Orthopade 1981)
 - 1) progression of symptoms
 - 2) constant pain interfering with activities of daily living
 - 3) absence of improvement of symptoms after conservative therapy

Arthroscopy

- # Ellman (1987): described his A/S technique
- # Weber (1991): intraoperative fluoroscopic guidance
- # Ark et al (Arthroscopy, 8:183-188, 1992)
 - Advantages: 1) a shorter rehabilitation time
 - 2) the possibility of a better functional result
 - 3) a better cosmetic appearance than after open surgery
 - Complete excision of the calcium deposit was not essential to achieve pain relief.
- # Jerosch et al (J shoulder and elbow, 7:30-37, 1998)
 - Removal of the calcific deposit and resection of the CA ligament (\pm)acromioplasty
 - Acromioplasty did not improve the results.
 - Removal of an as much of the calcific deposit as possible would lead to improved outcomes and should be the goal of A/S treatment.
- # Procedures:
 - 1) beach-chair position under G/A or interscalene block.
 - 2) Inspection of the G-H joint.
 - : A vascular injection pattern on the articular surface of RC— indication an inflammatory response to the calcific deposit—this should be marked with a suture.
 - 3) palpating, needling, irrigation
 - 4) (\pm) subacromial decompression
 - 5) suction drain

Open Procedures

Summary

- Usually self-limiting disease

- Nonoperative management is still the treatment of choice
- Needle technique or surgical removal may be indicated.
- The trend is toward arthroscopic management
- If large defect, close the defect arthroscopically.

References

1. Aina R, Cardinal E, Bureau NJ, Aubin B, Brassard P: Calcific shoulder tendinitis: treatment with modified US-guided fine-needle technique. *Radiology* 2001;221(2):45-61.
2. Archer RS, Bayley JIL, Archer CW, Ali SY: Cell and matrix changes associated with pathological calcification of the human rotator cuff tendons. *J Anat* 1993;182:1-12.
3. Ark JW, Flock TJ, Flatow EL, Bigliani LU: Arthroscopic treatment of calcific tendinitis of the shoulder. *Arthroscopy* 1992;8:183-188.
4. Bateman JE.: The neck and shoulder. Philadelphia: WB Saunders Co.; 1978.
5. Bosworth BM.: Calcium deposits in the shoulder and subacromial bursitis. A survey of 12,122 shoulders. *JAMA* 1941;116:2477-82.
6. Bosworth BM.: Examination of the shoulder for calcium deposits. Technique of fluoroscopy and spot film roentgenography. *J Bone Joint Surg* 1941;23:567-77.
7. Brewer BJ: Aging of the rotator cuff. *Am J Sports Med* 1979;7:102-110.
8. Codman EA: The Shoulder: Rupture of the Supraspinatus Tendon and Other Lesions in or About the Subacromial Bursa. Boston: Thomas Todd, 1934, pp 178-215.
9. Comfort TH, Arafiles RP. Barbotage of the shoulder with image-intensified fluoroscopic control of needles placement for calcific tendinitis. *Clin Orthop* 1978;135:171-8.
10. Constant CR, Murley AHG. A clinical method of functional assessment of the shoulder. *Clin Orthop* 1987;214:160-4.
11. Daecke W, Kusinierczak D, Loew M. Long-term effects of extracorporeal shockwave therapy in chronic calcific tendinitis of the shoulder. *J Shoulder Elbow Surg* 2002;11(5):476-80.
12. DePalma AF, Kruper JS: Long -term study of shoulder joints afflicted with and treated for calcific tendinitis. *Clin Orthop* 1961;20:61-72.
13. deS' eze S, Welfling J: Tendinites calcifiantes. *Rhumatologie* 1970;22:45-50.
14. Ebenbichler GR, Erdogmus CB, Resch KL, Funovics MA, Kainberger F, Barisani G, et al. Ultrasound therapy for calcific tendinitis of the shoulder. *N Engl J Med* 1999;340(20):1533-8.
15. Ellman H. Arthroscopic subacromial decompression. Analysis of one- to three-year results. *Arthroscopy* 1987;3(3):173-81.
16. Farin PU, Rasanen H, Jaroma H, Harju A. Rotator cuff calcifications: treatment with ultrasound-guided percutaneous needles aspiration and lavage. *Skeletal Radiol* 1996;25(6):551-4.
17. Gschwend N, Scherer M, Lohr J: Die Tendinitis calcarea des Schultergelenks(T.c). *Orthopade* 1981;10:196-205.
18. Hamada J, Ono W, Tamai K, Saotome K, Hoshino T. Analysis of calcium deposits in calcific periartthritis. *J Rheumatol* 2001;28(4):809-13.
19. Harmon PH. Methods and results in the treatment of 2580 painful shoulders with special reference to calcific tendinitis and the frozen shoulder. *Am J Surg* 1958;95:527-44.
20. Hartig A, Huth F: Neue Aspekte zur Morphologie und Therapie der Tendinosis calcarea der

- Schultergelenke. Arthroskopie 1995;8:117-122.
21. Herberts P, Kadefors R, Hogfors C, Sigholm G: Shoulder pain and heavy manual labor. Clin Orthop 1984;191:166-178.
 22. Jerosch J, Strauss JM, Schmiel S: Arthroscopic treatment of calcific tendinitis of the shoulder. J Shoulder Elbow Surg 1998;7:30-37.
 23. Jim YF, Hsu HC, Chang CY, Wu JJ, Chang T. Coexistence of calcific tendinitis and rotator cuff tear: an arthrographic study. Skeletal Radiol 1993;22(3):183-5.
 24. Litchman HM, Silver CM, Simon SD, Eshragi A. The surgical management of calcific tendinitis of the shoulder. An analysis of 100 consecutive cases. Int Surg 1968;50(5):474-9.
 25. Lippmann RK: Observations concerning the calcific cuff deposit. Clin Orthop 1961;20:49-60.
 26. Loew M, Daecke W, Kusnierczak D, Rahmanzadeh M, Ewerbeck V. Shock-wave therapy is effective for chronic calcifying tendinitis of the shoulder. J Bone Joint Surg [Br] 1999;81(5):863-7.
 27. Loew M, Jurgowski W, Mau HC, Thomsen M: Treatment of calcifying tendinitis of rotator cuff by extracorporeal shock waves: A preliminary report. J Shoulder Elbow Surg 1995;4:101-106.
 28. Loew M, Sabo D, Wehrle M, Mau H. Relationship between calcifying tendinitis and subacromial impingement: a prospective radiography and magnetic resonance imaging study. J Shoulder Elbow Surg 1996;5(4):314-9.
 29. McLaughlin HL: Lesions of the musculotendinous cuff of the shoulder; III. Observations on the pathology, course and treatment of calcific deposits. Am Surg 1946;124:354-362.
 30. McLaughlin HL. The selection of calcium deposits for operation: the technique and resultant operations. Surg Clin N Am 1963;43:1501-4.
 31. Mohr W, Bilger S: Morphologische Grundstrukturen der kalzifizierten Tendopathie und ihre Bedeutung für die Pathogenese. Z Rheumatol 1990;49:346-355.
 32. Neer CS II: Impingement lesions. Clin Orthop 1983;173:70-77.
 33. Neviaser RJ. Painful conditions affecting the shoulder. Clin Orthop 1983;173:63-9.
 34. Olsson O: Degenerative changes of the shoulder joint and their connection with shoulder pain: A morphological and clinical investigation with special attention to the cuff and biceps tendon. Acta Chir Scand Suppl 1953;181:5-130.
 35. Painter C. Subdeltoid bursitis. Boston Med Surg J 1907;156:345-9.
 36. Patterson RL, Darrach W. Treatment of acute bursitis by needle irrigation [abstract]. J Bone Joint Surg 1937;19:993.
 37. Perugia L, Postacchini F: The pathology of the rotator cuff of the shoulder. Ital J Orthop Traumatol 1985;11:93-105.
 38. Remberger K, Faust H, Keyl W: Tendinitis calcarea: Klinik, Morphologie, Pathogenese und Differential diagnose. Pathologie 1985;6:196-203.
 39. Robertson VJ, Baker KG. A review of therapeutic ultrasound: effectiveness studies. Phys Ther 2001;81(7):1339-50.
 40. Rochwerger A, Franceschi JP, Viton JM, Roux H, Mattei JP. Surgical management of calcific tendinitis of the shoulder: an analysis of 26 cases. Clin Rheumatol 1999;18(4):313-6.
 41. Rompe JD, Rumler F, Hopf C, Nafe B, Heine J: Extracorporeal shock wave therapy for calcifying tendinitis of the shoulder. Clin Orthop 1995; 321:196-201.
 42. Rowe CR. Calcific tendinitis. AAOS Instr Course Lect XXXIV 1985;34:196-8.
 43. Sarkar K, Uthoff HK: Ultrastructural localization of calcium in calcifying tendinitis. Arch Pathol Lab Med 1978;102: 266-269.

44. Sengar DPS, McKendry RJ, Uhthoff HK: Increased frequency of HLA-A1 in calcifying tendinitis. *Tissue Antigens* 1987; 29: 173-174.
45. Simon WH. Soft tissue disorders of the shoulder. Frozen shoulder, calcific tendinitis, and bicipital tendinitis. *Orthop Clin N Am* 1975;6:521-38.
46. Uhthoff HK, Loehr JW. Calcific Tendinopathy of the Rotator Cuff: pathogenesis, diagnosis, and management. *J Am Acad Orthop Surg.* 1997;5(4):183-91.
47. Uhthoff HK, Sarkar K: Calcifying tendinitis, in Rockwood CA Jr, Matsen FA III(eds):*The Shoulder*. Philadelphia: WB Saunders, 1990, vol 2, pp 774-790.
48. Uhthoff HK, Sarkar K, Maynard JA: Calcifying tendinitis: A new concept of its pathogenesis. *Clin Orthop* 1976; 118:164-168.
49. Weber SC. Technique and results of arthroscopic treatment of calcific tendonitis of the rotator cuff using fluoroscopic localization [abstract]. *Arthroscopy* 1991;7(3):322.
50. Wolf III WB. Shoulder tendinoses. *Clin Sports Med* 1992;11(4):871-90.