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Dorsal ganglion of the wrist – pathogenesis and biomechanics

Operative v. conservative treatment

C. M. DE VILLIERS, R. H. BIRNIE, L. K. PRETORIUS. G. J. VLOK

Summary

It is shown that the dorsal ganglion arises as a herniation from the dorsal scapholunate ligament. This herniation increases in size (according to La Place's law) owing to the unidirectional pinchcock effect of the mucosal folds of the duct and the pressure of the overlying extensor retinaculum until the distending pressure inside the ganglion equals the overlying tissue pressure. Wrist gangliography, retrograde wrist arthrography, histology and nuclear magnetic resonance were used to prove this conclusively. Bearing the pathogenesis in mind, the best clinical results were obtained by excision of the ganglion with 0,5 cm^2 of dorsal scapholunate ligament and closure of the dorsal capsule with a 3/0 Vicryl purse-string suture. Non-surgical sclerotherapy led to severe inflammation and sepsis and a recurrence rate of 45%. Conservative therapy is illogical since the communicating duct remains and synovial fluid from the scapholunate joint will cause a reherniation and recurrence of the ganglion.

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The dorsal ganglion of the wrist is a synovial-lined cystic swelling communicating with and arising from the wrist joint. It is the most common soft-tissue tumour in the hand.[1] At Tygerberg Hospital 9,3% of all hand surgery is for dorsal wrist ganglion. The sex ratio for men and women is 1:1,4, while the vocational predominance of manual over sedentary work is 2,5:1 (Fig. 1).

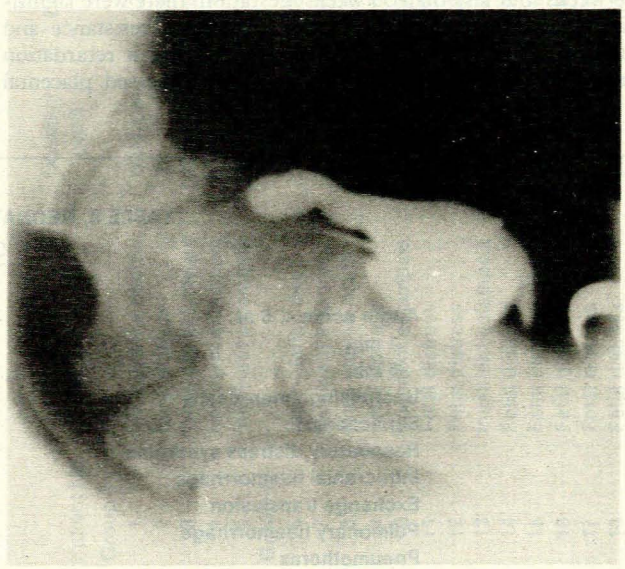

Fig. 1. Retrograde gangliogram of dorsal wrist ganglion (note proximal unidirectional valve).

Biomechanics

The proximal and distal row of carpal bones are linked by the scaphoid bone. Radial and ulnar deviation, as well as dorsi- and palmar flexion take place in an intercalated manner about the lunate bone,[2] the centre of rotation being in the base of the capitate. Thus maximal pressure occurs in the dorsal scapholunate ligament. From the above it is clear why 80% of all acute traumatic carpal injuries occur where the lesser and greater arcs of rotation coincide (Fig. 2).

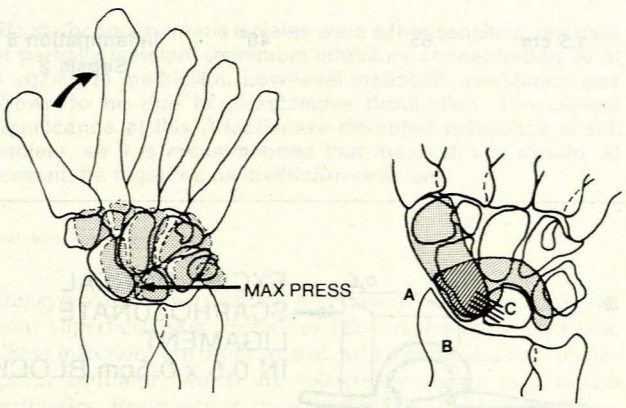

Fig. 2. Carpal bone movement during ulnar deviation (left) and vulnerable zone of the carpus (right) (A = greater arc injury; B = lesser arc injury; C = complementary area).

Pathogenesis

Conventional theory.[2] Owing to chronic trauma, mucinous degeneration of collagen fibres results in the formation of multiple cysts which coalesce and multipotential mesenchymal cells in the cyst undergo metaplasia into synovial-like cells secreting mucin. This cyst or ganglion does not communicate with the wrist joint (Fig. 3).

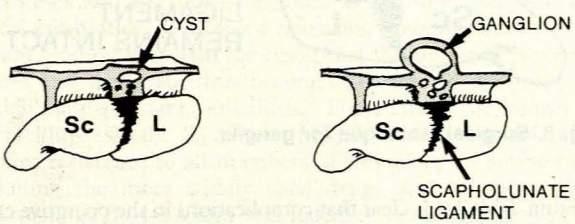

Fig. 3. Conventional theory of the development of dorsal ganglia.

Authors' theory. With increased pressures in the scapholunate ligament during wrist movements and with acute or repeated trauma, there is a herniation of the synovial-lined capsule into the doral scapholunate ligament. This cystic herniation increases in size and follows the path of least resistance until it reaches an equilibrium when the pressure inside the cyst equals that of the overlying tissue (guided by La Place's law), i.e. $Pg = \frac{T+}{r}$, where Pg is pressure in the ganglion, T+ is the tension in the cyst wall and r is the radius of the ganglion. Initially the ganglion develops slowly (due to increased Pg caused by r) and is painful.[3] But as r increases, the distending Pg required is less and the ganglion grows rapidly. However, the Pg is higher than the pressure in the wrist because of: (*i*) the mucosal folds of the duct; (*ii*) the Bunsen-valve effect of the overlying extensor retinaculum; and (*iii*) the pinch-cock effect of the base of the ganglion on the duct (Fig. 4). The above valves in the communicating duct of the ganglion were proved by prograde arthrography (Fig. 5), gangliography (see Fig. 1), by microscopy and magnetic resonance

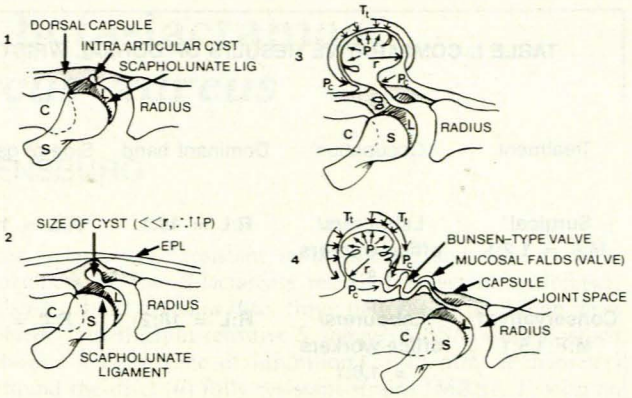

Fig. 4. Pathogenesis and development of dorsal ganglia (T_t = tissue tension; P = pressure in wrist joint; r = radius of ganglion; P_c = pinchcock valve. LaPlace's law: $P = \frac{T_t}{r}$).

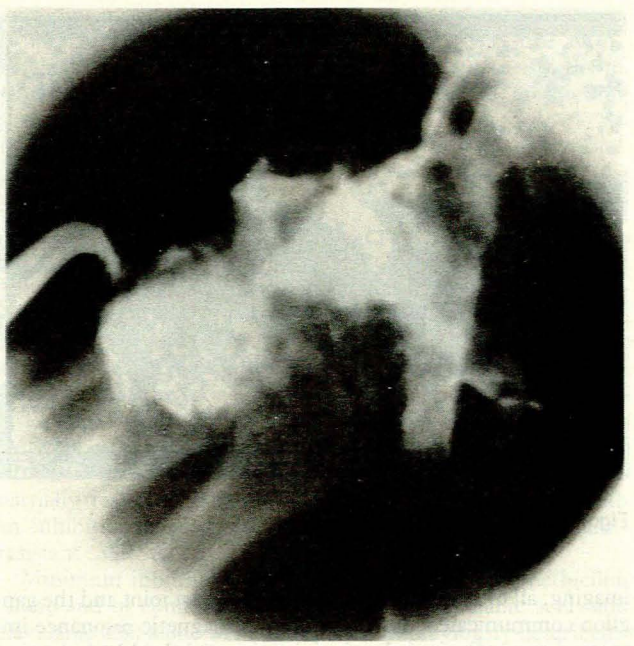

Fig. 5. Prograde arthogram of wrist.

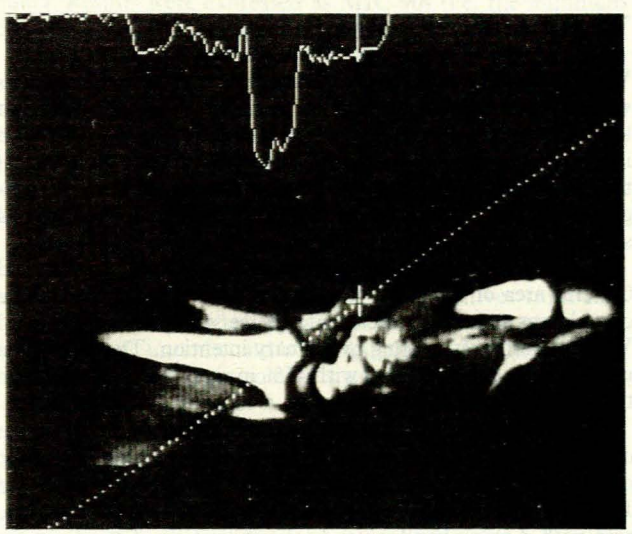

Fig. 6. T_1 magnetic scan of ganglion.

TABLE I. COMPARATIVE RESULTS OF DORSAL WRIST GANGLIA TREATED OPERATIVELY AND CONSERVATIVELY

Treatment	Occupation	Dominant hand	Side of ganglia	Av. size of ganglia	Assoc. with trauma (%)	Postop. recurrence rate (%)	Complications
Surgical* M:F = 1,2:1	**Labourers/ office-workers 1,8:1**	**R:L = 19:1**	**R:L = 19: 1**	**1,2 cm**	**50**	**5**	**Inflammation 1 Sepsis 0**
Conservative† M:F 1,5:1	**Labourers/ office-workers = 1,6:1**	**R:L = 18:2**	**R:L = 1:1**	**1,5 cm**	**65**	**48**	**Inflammation 6 Sepsis 2**

* Total excision and primary suture of dorsal capsule.
† Needle aspiration, cortisone infiltration and compression.

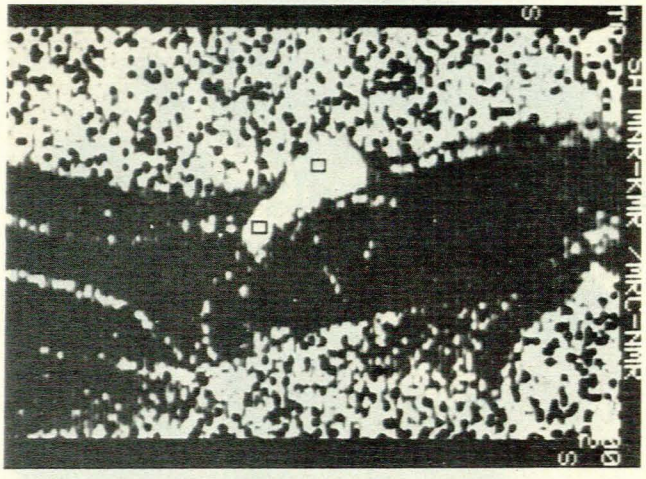

Fig. 7. T_2 magnetic scan of ganglion.

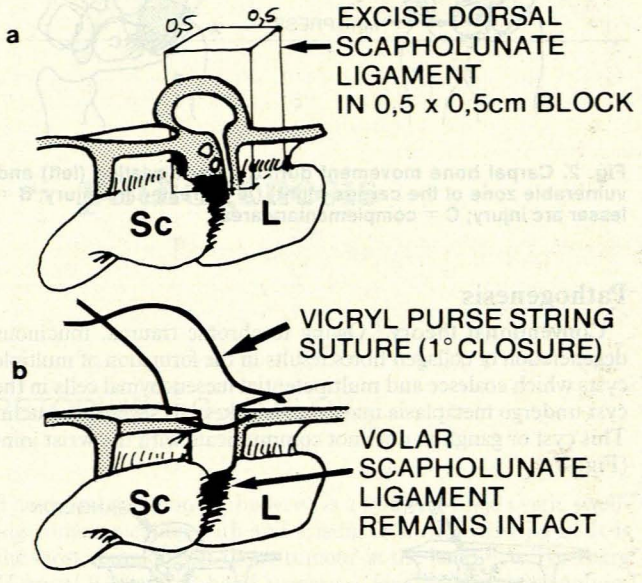

Fig. 8. Surgical technique for ganglia.

imaging, all of which confirmed that the wrist joint and the ganglion communicated. Furthermore, on magnetic resonance imaging the ganglionic and wrist joint synovial fluid had identical densities on G and on T scales (Figs. 6 and 7).

Treatment

World-wide figures for recurrence rates are 45% in operative as well as non-operative methods of treatment.[4] It is evident that the high recurrence rate is due to the communicating duct with its unidirectional valves between the wrist and the ganglion. If the ganglion was only incised, or even if it was excised, the ganglion would recur through the defect left in the dorsal scapholunate ligament.

We treated 20 patients by excision of the ganglion, its duct and 0,5 cm^2 area of the scapholunate ligament. This defect in the capsule was sutured by means of a purse-string suture using 3/0 Vicryl, resulting in healing by primary intention. The recurrence rate was only 5% compared with 45% in reported series in which the suture was *not* used (Fig. 8).

A further 20 patients were treated conservatively by aspiration of the ganglion with an 18-gauge needle, followed by infiltration of the ganglion with a mixture of 1 ml 5% hyaluronidase and 1 ml hydrocortisone. This was followed by compression of the area with a crêpe bandage and immobilisation of the wrist for 2 weeks. The recurrence rate was 48% (Table I).

From Table I it is clear that complications in the operative cases were mild compared with conservative treatment.

Thus the most effective treatment of dorsal ganglia of the wrist is excision of the ganglion, its communicating duct and 0,5 cm^2 of the dorsal scapholunate ligament, followed by closure of the defect in the capsule by 3/0 Vicryl suture and drainage of the wound area by a Penrose-type drain. Care must be taken not to damage or disrupt the volar scapholunate ligament since this can lead to rotational instability of the scaphoid and scapholunate dissociation.[5,6]

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