

MADELUNG'S DEFORMITY

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MADELUNG'S deformity may be described as an idiopathic, progressive curvature of the radius due to a dyschondroplasia of the inferior radial epiphysis, resulting in a deformity of the wrist, giving it the appearance of an anterior (or, more rarely, a posterior) subluxation of the hand. Several earlier authors, including Madelung himself, have accredited Dupuytren with the first reference to this condition, while others have given it the double patronym of "Dupuytren-Madelung," but Stetten,²²¹ who has carefully examined Dupuytren's right to this distinction, finds that it cannot be substantiated. Dupuytren's report,⁷⁸ in 1834, is based on a quotation taken, by his own admission, from Bégin,¹¹ who, in 1825, noted among adult male workers, not the typical spontaneous deformity, but a true forward dislocation of the wrist as a result of occupation. Other similar reports of a vague²¹³ or secondary static deformity¹³⁰ appeared soon after.

Probably the first description of the true deformity was that by Malgaigne,¹³⁸ in 1855, while in 1875 Jean¹¹⁵ reported the first definite anatomic dissection. But the credit for first presenting a clear picture of it as a distinct clinical entity reverts to Madelung,¹³⁵ who, in 1878, before the Seventh Congress of German Surgeons, described the condition as a disturbance of growth in the joints, analogous to pes valgus, genu varum and scoliosis, and regarded it as a subluxation of the wrist joint. It remained for Duplay,⁷¹ in 1885, to point out that the deformity was a result of volar bowing of the distal end of the radius.

Practically all that has been written on this subject has appeared in the French, German and Italian literature, and it was this fact, together with the paucity and meagerness of references to the subject in the various textbooks, that prompted Stetten,²²¹ in 1909, to describe, in American literature, a case of the deformity which he had previously reported²²⁰ abroad, and at the same time presented a complete review of the literature relating to it. Although he definitely mentions several previously reported cases in America, he has been misrepresented by subsequent authors as having reported the first case from this country. At the present time one finds the reports of cases of this condition in a deplorable state. They are inadequate, often vague and unconvincing, while references are meager and all too frequently incorrect. Instead of being content with a case report, a quasi review of the

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literature has been presented which merely serves to perpetuate the inaccuracies of previous writers.

Pooley,¹⁷⁶ in 1880, evidently totally unaware of Madelung's report, described the first authentic case in American literature. Kieffer,¹²⁰ in 1902, briefly described another; Peckham,¹⁶⁵ in 1907, poorly presented a questionable case in a girl, age 14. Brinsmade,²⁸ in 1909, reported the fourth case; Stetten²²¹ wrote his incomparable article in 1909; a few months later Peckham and Hammond,¹⁶⁶ in a presentation of interesting cases from their clinic, reported two cases (Nos. 3 and 4) as examples of Madelung's deformity. In one of these no evidence or description warranting a definite diagnosis of the genuine deformity is given, although the other case (No. 3) is an excellent example of the rare reverse type of the deformity. Stokes²²³ added two more American cases in 1910, while in 1911, Jones¹¹⁶ briefly described another case, and Taylor²²⁵ reported two cases in 1912. In 1914, Adler⁴ briefly described a case which he called Madelung's deformity, while in 1915, Parkes¹⁶⁴ reported a case upon which he had operated with excellent results. In 1916, Earl⁷⁴ gave a good presentation of an early case of the deformity.

Despite the availability of these reports in American literature, or at least their mention in Stetten's article, Brown,³¹ in 1924, reported his case as "the fourth case reported in America," while in the same year Levyn,¹³² realizing Brown's mistake, as he thought, wrote a "report of two cases constituting the fifth and sixth American cases," when in truth they were really the sixteenth and seventeenth. Also in 1924, Moore¹⁵⁴ reported two cases upon which he had operated, while in 1936, Claiborne⁴³ reported a case. Emboldened by a thorough, methodical and exact survey of the related American literature, we feel we are correct in reporting the case herein cited as the twenty-first from this country. Two reports^{162, 238} have not been included in this series since they obviously do not fall into the category of a true Madelung's deformity, presenting, as they both do, lesions of the ulna and not of the radius.

Comprehensive reviews on this subject have appeared from time to time. In 1903, Abadie¹ compiled a bibliography reporting 41 known cases of the deformity which he had succeeded in collecting. Gasne⁹⁵ reviewed the subject in 1906, but did not add any new cases. In 1907, Estor⁷⁷ published a total of 85 cases. Stetten²²¹ collected, and gave brief summaries of 62 cases up to 1908. In 1908, Siegrist²¹² tabulated 58 cases, and Franke,⁸⁷ only 56. In 1909, Marsan¹⁴⁰ listed 90 cases; in 1911, Ramos¹⁸⁵ listed 69 cases, while in 1913, Melchior,¹⁵² after reviewing the subject, accepted only 75 cases, while in 1933, Salisachs²⁰³ reported a total of 133 known cases.

The discrepancy in these figures is obvious, and is due to the considerable difference of individual opinion as to what constitutes a true instance of this deformity and on what evidence it is to be accepted. Although only five cases reported by Madelung are specific enough for acceptance, he claims to have seen 12, and he is sometimes credited with that number. In the discussion of Madelung's paper,¹³⁵ Czerny claimed to have seen two cases,

Hirschberg two cases, and similar cases were claimed to have been noted by Langenbeck, but Abadie¹ discards their claims, being unable to find published reports of their observations.

In the discussion of Gangolphe's paper,⁹² Bérard¹⁵ described a case of his own, which Stetten is inclined to accept as genuine, but which we have discarded as being too indefinite for acceptance. After describing a case occurring in mother and daughter, Guépin¹⁰⁴ reports a similar deformity in 14 other members of the family, while Féré⁸³ claims to have seen 25 cases in male epileptics. We are rather reluctant to embody these figures into our own statistics. We have found, as Stetten also remarks, considerable difficulty in knowing just which cases one should incorporate. In our own tabulation, we have tried to follow Stetten's criteria in rigidly rejecting all cases where:

(1) There is a reasonable doubt as to the actual existence of a typical Madelung's deformity, and a probability that the condition was some other pathologic lesion.

(2) The deformity was of such a slight degree that it could scarcely be considered abnormal.

(3) The description was too vague or the reference too indefinite to justify inclusion.

Also tending to upset an accurate statistical compilation is the occasional report of the same case by two men, as it occurs in the articles by Weber²³⁵ and Busch,³⁵ and Müller¹⁵⁵ and Franke.⁸⁷ Stetten himself has reported the same case in two journals,^{220, 221} while it has been a common practice for several of the authors to rearrange their primary case report in subsequent articles.

In view of the foregoing, we have attempted to eliminate these inaccuracies from the literature, and have compiled a chart tabulating 171 cases which we have succeeded in collecting.

We cannot agree with Claiborne⁴³ in assuming that with the increasing number of examinations which are resulting from the Workmen's Compensation Act, and with the wider use of roentgenologic examinations in traumatic surgery, there will be more observations and reports of this condition, since the type of patient presenting a true Madelung's deformity does not come from either of these two groups. We do believe, however, that the condition is not so rare as the literature would seem to indicate, since it is not frequently recognized, especially without the aid of the roentgenologist.

Case Report.—Hosp. No. 69356: M. D., female, age 18, was admitted to the Cumberland Hospital, January 31, 1938, to the service of Dr. G. B. Reitz, complaining of pain in, and deformity of, both wrists during the past two years. She was born April 1, 1920, in the United States, and no history was obtainable of any birth injury having occurred. She had had measles, whooping cough and diphtheria. At age 9, she was struck by an automobile, but there was no history or evidence of any local injury to the wrists. She had not engaged in any particular occupation which might account for her deformity. Her mother, age 47, three sisters and two brothers are all living and well. Her father died of pneumonia at age 47. There were no deformities or any

indication of syphilis or rickets in either parent or in any of her five brothers and sisters.

Physical Examination revealed a well developed, well nourished girl, 160 cm. tall, weighing 50 kg. Temperature, 99.2° F.; pulse, 84; respirations, 16; blood pressure, 130/65. The visible mucous membranes are of good color and the teeth are in good condition.

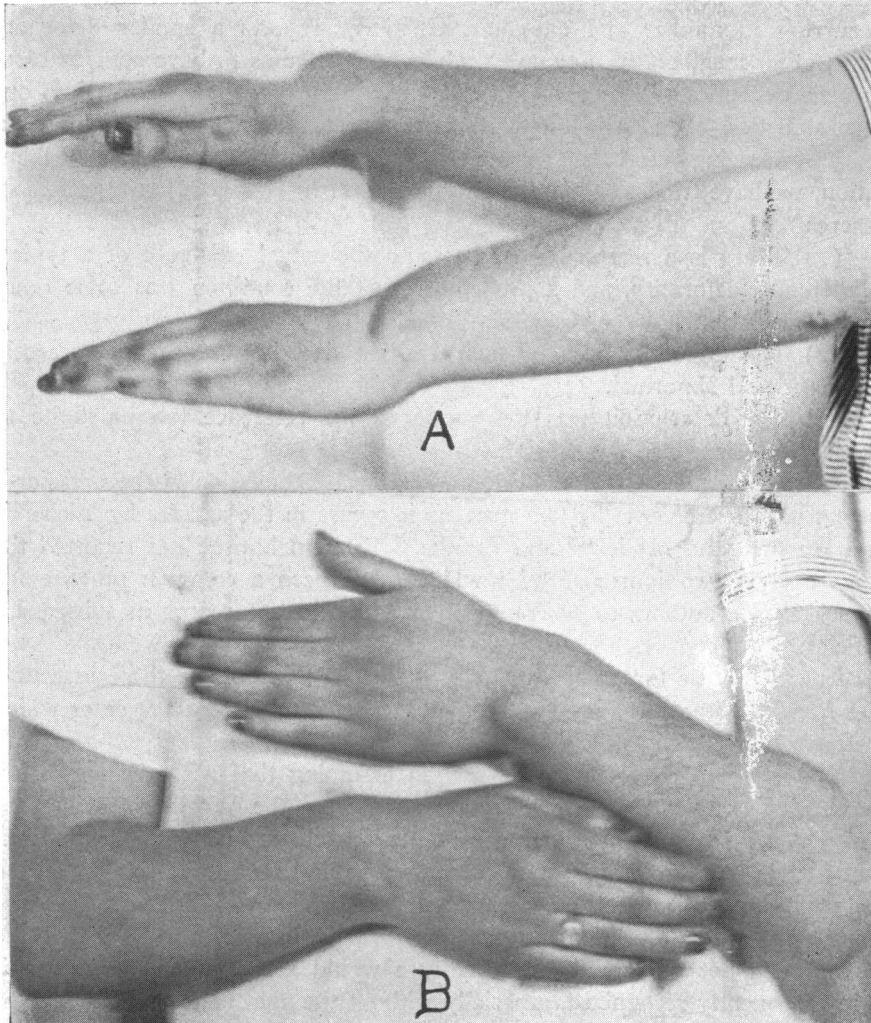


FIG. 1.—(A) Lateral view showing the characteristic bayonet-shaped deformity and the shortening in the length of both forearms.
(B) Anteroposterior view showing the prominence of the head of the ulna at the back of the wrist, and the ulnar deviation of the hand.

The organs of special sense, and the thoracic and abdominal viscera are all apparently normal, and there are no sensory, trophic or vasomotor disturbances. There are no frontal or parietal bosses, the thorax is well formed and there is no scoliosis, rachitic rosary or Harrison's groove. The hips and knees are normal and the tibiae are perfectly straight. There is no broadening of the epiphyses.

One is immediately struck by a curious bilateral deformity at both wrists (Fig. 1 A

TABULATION OF ANALYSES OF RELEVANT DATA OF 171 CASES OF TRUE MADELUNG'S DEFORMITY

No.	Author and Year	Age and Sex	Occupation	Age at Onset	Casual Relationship	Hereditary	Unilateral or Bilateral	Wrist Joint		Examination	Other Abnormalities	Treatment	Course or Result
								Symptoms	Function				
1.	Maigne 1855	36 M.	Mason	10-12	Fracture middle of radius 3 yrs. before onset	—	Unilateral	Pain at onset for 18 mos.	Good, except for extension and pronation	Radius: Bowed at lower extremity	Exostosis of radius, just above wrist	Unsuccessful attempt at reduction	Progressed 18 mos.
2.	Weber 1859	16 F.	—	12-15	No history of trauma	—	Right	Pain at onset and on motion	Extension limited	Radius and ulna: Project at back of wrist. Carpus: Apparently displaced anteriorly	—	Reduction under narcosis but recurrence. Reduced and maintained with plaster enlacement and apparatus	Gradual progress (was later operated upon by Busch—see below)
3.	Busch 1864	21 F.	—	12-15	No history of trauma	—	Bilateral	Pain on working	Limitation of motion	Apparent anterior displacement of the hand	—	—	Result poor; progression
4.	Jean 1875	73 F.	—	Childhood	Congenital?	—	Bilateral, more marked on right	—	Extension limited	Radius: Lower extremity bowed forward. Ulna: Dislocated backward. Carpus: Displaced forward	Hyperostosis of the head of the ulna	Autopsy Dissection	—
5.	Madelung 1878	20 F.	—	Childhood	No history of trauma	—	Left	—	—	Carpus and hand: Dislocated forward on wrist. Radius: Bowed forward at epiphysis.	—	Autopsy Dissection	—
6.	Madelung 1878	18 F.	Peasant	15	—	—	Bilateral	Pain on extension	Interference with work	Apparent forward dislocation of hand and wrist.	—	Avoidance of extension and hard work. Leather wrist bracelet	Pain relieved
7.	Madelung 1878	16 F.	Wealthy family	—	—	—	Right	Pain on extension	—	—	—	Leather wrist bracelet	Pain relieved
8.	Madelung 1878	14 M.	Tanner	—	Lifted heavy weights	—	Bilateral	Pain during development	Extension limited	Prominence of the head of the ulna at the back of the wrist	—	Avoided heavy work. Leather wrist bracelet	Pain relieved
9.	Madelung 1878	15 F.	—	Childhood	—	—	Left	Pain on extension	Extension limited	Marked subluxation forward of carpus and hand	—	Leather wrist bracelet	Pain relieved
10.	Pooley 1880	33 F.	Dairymaid	8	No history of trauma or local disease	—	Bilateral	Pain on milking cows and on hard work	Extension limited; flexion increased	Ulna: Styloid prominent. Radius and ulna: Apparently shortened. Carpus: Dislocated forward	Hyperostosis of the ulnar head	—	—
11.	Felix (Tripier) 1884	F.	Laundress	14	—	—	Bilateral, more marked on left	Severe pain at onset	Motion disturbed; supination impossible	Ulna: Dislocated backward. Carpus and hand: Subluxated forward	—	Orthopedic appliance; electricity	Recurrence of deformity
12.	Duplay 1885	F.	—	9	Strained wrist 1-2 yrs. before	—	Left	—	No loss of motion	Radius: Lower end bent forward. Ulna: Lower end dislocated backward. Carpus and hand: Apparent subluxation forward	Scoliosis. Hyperostosis of the ulnar head	Failure of orthopedic appliance. Linear osteotomy 3 cm. above joint	Result: Good
13.	von Bergmann 1888	F.	—	Childhood	No history of trauma	—	Bilateral	Severe pains at onset	Extension limited	Apparent forward subluxation of carpus and hand on wrist	Bilateral shortening of the fourth metacarpals	—	Gradual progression
14.	Duplay 1891	14 F.	—	7	—	—	Bilateral, more marked on right	Easily fatigued. Vague pains at onset	Slight disturbance of motion	Radius: Lower end bent forward. Ulna: Slightly bent forward. Carpus and hand: Displaced anteriorly	Hyperostosis of the ulnar head	—	Course: 4 to 6 mos.
15.	Bode 1891	F.	—	13	—	—	Left	—	—	Ulna displaced forward (?)	Hemiatrophy of the right side	Deformity reducible on pressure	Recurs
16.	Bennett 1891	24 F.	Cook	23	No trauma. No rheumatism	—	Bilateral, especially the right	Increasing weakness of wrists; must stop work	—	Ulna: Dislocated backward from radius and carpus. Carpus and hand: Displaced anteriorly	—	Deformity on right side reducible by pressure	—
17.	Guepin 1892	F.	—	Childhood	Slight trauma to left wrist as an infant	Mother, father, brothers, sisters, uncles and aunts, nephews and nieces (14 members of the family) have similar deformities	Bilateral, especially the right	—	—	Right radius: Completely dislocated forward from the ulna. Displacement of the carpus from the ulna complete, and from the radius nearly so. Articular ends of the radius and ulna project under the skin. Left radius: Displacement only partial representing an early phase of the deformity on the right	—	Deformity of both sides can be reduced by pressure, under anesthesia	Spontaneous, immediate recurrence of the deformity
18.	Guepin 1892	F.	—	—	—	Mother of above	Bilateral	—	—	Ulna: Dislocated backward from radius and carpus. Carpus and hand: Dislocated from ulna, and subluxated from the radius	—	—	—
19.	Redard 1892	F.	Washwoman	14	No rickets. History of fall on hand	—	Bilateral	Active pain especially on wringing wash	Motion limited, especially extension and supination	Radius: Marked forward bowing. Ulna: Slightly bowed forward. Carpus and hand: In position of subluxation	No stigmata of rickets	Rest; galvanism	—
20.	Malfuson 1894	F.	Seamstress	13	History of having wrenched hands	Mother has same deformity	Bilateral, more marked on right	Intermittent pain	Extension limited and supination painful on right side only	Radius: Slight bowing of the lower quarter of shaft. Carpus and hand: Subluxated forward; and hand displaced toward the ulna	Mild scoliosis	Massage; sulphur baths; iodine	—
21.	Malfuson 1894	F.	—	—	—	Mother of above	Bilateral	No pain	No disturbance of function	Radius: Bowed forward. Carpus and hand: Subluxated at wrist	—	—	—
22.	Jagot 1897	21 F.	Milkmaid	13-14	Hard work	Father, uncle and grandfather have large wrists	Bilateral	No pain	Extension and lateral motion limited	Radius: Bowed forward. Ulna: Dislocated backward. Carpus and hand: Displaced forward. Roentgenogram	Hypertrophy of lower third of the ulna	—	—
23.	Nélaton 1897	—	—	—	—	—	Unilateral	Dissected Specimen	—	Radius: Bowed forward. Carpus and hand: Displaced anteriorly	—	Dissected Specimen	—
24.	Guffy 1898	M.	Carpet-weaver	13	History of strain to wrist	—	Left	Marked pain in wrist	Flexion and abduction increased; extension and adduction diminished	Radius: Articular surface deviated anteriorly. Ulna: Dislocated backward from carpus and hand: Displaced forward and to the ulnar side, but in normal relation to the radius. Roentgenogram	Hyperostosis of the head of the ulna	Plaster enlacement 2 wks., with hand in extension and half pronation. Leather bracelet	Recurrence after reduction, but gradual improvement
25.	Delbet 1899	16 F.	—	12	Denies any history of trauma	—	Bilateral	Pain	Disturbance in ability to write	Radius: Bowed forward at lower end. Ulna: Dislocated backward. Carpus and hand: Displaced anteriorly and toward ulna	—	Linear osteotomy of the lower end of the radius. Plaster enlacement	Course: 4 yrs. Tendency to recurrence
26.	Cabeza 1899	F.	Pianist	14	No history of trauma	—	Bilateral, mostly right	Pain at the beginning	Normal motion	Radius: Bowed forward at lower end. Ulna: Dislocated backward. Carpus: Displaced forward. Roentgenogram	—	—	—
27.	Gangolphe 1899	F.	Embroiderer	14	No history of trauma. No stigmata of rickets	Mother has same deformity	Bilateral, especially right	Severe pain	Extension limited on right side	Radius: Bowed forward and toward ulna at lower end. Ulna: Dislocated backward. Roentgenogram	Slight scoliosis. Lax ligaments of left knee	—	—
28.	Gangolphe 1899	F.	Seamstress	11	No stigmata of rickets. No history of trauma	Mother of above	Bilateral, especially right	Easily fatigued; occasional pain	Extension, pronation and supination limited, especially on right	Radius: Bowed forward and toward ulna at lower end; right radius 3 cm. shorter than left. Ulna: Dislocated backward, right side shorter than left. Carpus and hand: Displaced forward, and to ulnar side. Roentgenogram	—	—	—
29.	Roget 1899	F.	—	8-10	No trauma. No rickets	Mother and grandfather have prominent ulnae	Bilateral, especially right	Fatigue on writing	—	Radius: Bowed forward and toward ulna at lower end. Ulna: Dislocated backward. Carpus and hand: Displaced forward and held in adduction	Cubitus valgus	—	Course: 6 yrs.
30.	Dekeyser 1901	F.	—	14	No history of trauma. No hard work	Mother has similar deformity	Right	—	Flexion increased	Radius: Shortened and lower end bent forward. Ulna: Dislocated backward. Carpus and hand: Displaced forward from ulna, in normal relation to radius. Roentgenogram	—	Rest	—
31.	Dekeyser 1901	F.	—	Childhood	—	Mother of above	Left	Fatigue, weakness, clumsiness	Flexion slightly diminished on left	Ulna: Shortened and bowed forward. Ulna: Dislocated backward. Carpus and hand: Displaced forward	—	—	Gradual progression
32.	Kirmison 1902	10½ F.	—	10	No rickets or trauma	—	Bilateral, mostly right	Fatigue; pain on flexion	Flexion diminished; abduction impossible; supination limited; extension and adduction increased	Radius: Lower end bowed back and toward ulna. Ulna: Displaced forward, also shortened. Carpus and hand: Displaced backward, in normal relation to radius. Roentgenogram	Right dorsal scoliosis with curvature of ribs and right scapula	Linear osteotomy of the lower end of the radius. Plaster bracelet	Good result
33.	Gevaert 1902	M.	Weaver	14	Work entails continuous traction	—	Bilateral	Fatigue, weakness and clumsiness	Flexion slightly diminished	Radius: Bent forward at lower end. Ulna: Dislocated backward. Carpus and hand: Displaced forward, in normal relation to radius. Roentgenogram	Dorsal scoliosis. Compensatory lumbar scoliosis. Genu valgum	Massage; electricity; passive motion	Course: 2 yrs. Result satisfactory
34.	Ardouin 1902	F.	Waitress	Childhood	No history of trauma	Brother has large wrists	Bilateral, more marked on left	Slight weakness	—	Radius: Bowed forward, shortened. Ulna: Dislocated backward, shortened. Carpus and hand: Displaced forward, in normal relation to radius. Roentgenogram	Slight scoliosis	—	—
35.	Abadie 1903	28 M.	Cook	13	Fall on hand at age 9, with possible fracture	—	Left	Weakness	All movements limited, especially pronation and supination	Radius: Lower end bowed forward. Ulna: Bowed in to radius and dislocated backward. Carpus and hand: Displaced forward, in normal relation to radius. Roentgenogram	Exostosis on left radius	—	Course: Several years
36.	Cnopf 1903	15 F.	—	12	No trauma or hard work	—	Right	No pain	Extension slightly limited	Radius: Shortened, dorsal concave bowing in upper third, moderate volar convexity in lower two-thirds. Sharp bend forward at lower end, deviation of joint surface toward ulna. Carpus and hand: Displaced forward. Roentgenogram	—	—	Course: 2½ yrs.
37.	Kieffer 1903	30 M.	Soldier	Infancy	Strenuous athletics	—	Bilateral, more marked on left	No pain	Not impaired	Ulna: Marked prominence of the styloid process at the back of the wrist, overlapping the carpus dorsally, and subluxated from the radius and carpus. Roentgenogram	—	—	—
38.	Bennecke 1904	F.	Printer	15	History of carrying heavy weights	—	Bilateral, especially the right	Pain at onset, and while at work	Extension limited; pronation and supination diminished	Radius: Bowed forward. Ulna: Dislocated backward, both shortened. Carpus and hand: Displaced anteriorly. First row of carpal bones wedge-shaped. Roentgenogram	Ulnar hyperostosis; slight scoliosis; cubitus valgus (right)	—	—
39.	Poulsen 1904	F.	—	12	—	—	Left	No pain	Extension and supination limited	Radius: Bent forward sharply turning joint surface in, shortened. Ulna: Displaced backward, shortened. Carpus and hand: Displaced forward and to radius. Roentgenogram	—	Oblique linear osteotomy. Bandaged in extension	Course: 4 yrs. Tendency to recur
40.	Poulsen 1904	F.	Servant	12	—	—	Bilateral, more marked on left	No pain	Slight limitation of supination	Radius: Shaft bent forward, especially at lower end, and also bowed toward ulna, with deviation of the joint surface. Ulna: Displaced backward. Carpus and hand: placed forward in normal relation to radius. Roentgenogram	—	Oblique linear osteotomy. Bandage	Course: 1 yr. Improvement
41.	Albertin and Leclerc 1905	F.	Corsetmaker	Childhood	Both arms pulled violently at age 5	—	Bilateral	Pain and cramps on overwork	Flexion and abduction slightly exaggerated	Radius: Curved forward. Ulna: Dislocated backward on radius. Carpus and hand: Apparently displaced forward. "Pyramidalization" of first row of carpus	—	Ulnar dislocation can be reduced by pressure	Recurs
42.	Schule 1905	F.	—	9	Hand twisted at play	—	Right	No pain. Easily fatigued, especially playing piano	Extension limited; abduction slightly; adduction considerably	Radius: Lower half bowed forward. Ulna: Displaced backward and elongated. Hand: Displaced forward	Cubitus valgus. Congenital dislocation of both hips	Massage; electricity. Bandaged in extension	—
43.	Volkmann 1905	F.	—	16	—	Younger sister has indication of same deformity	Bilateral	No pain	Flexion and supination limited	Radius: Lower third bowed forward and toward ulna, shortened. Ulna: Dislocated backward, shortened. Carpus: Displaced anteriorly, in relation to articular surface of the radius. Roentgenogram	—	None	Irreducible
44.	Volkmann 1905	F.	—	14	—	Mother and grandmother have same deformities	Bilateral, especially the right	No pain	No serious disturbance of motion	Radius: Bowed. Ulna: Dislocated backward. Carpus and hand: Displaced anteriorly. Roentgenogram	Cubitus valgus; pes planus	None	Ulna reducible on pressure but recurs
45.	Natvig 1905	M.	—	14	Weak as an infant	—	Bilateral, more marked on right	Pain at onset	Extension and supination limited	Carpus: Displaced forward	—	—	—
46.	Solberg 1906	34 M.	Policeman	16½	—	Parents were cousins. Brother has similar deformity	Bilateral, especially the right	Pain at onset, and fatigue on doing heavy work	No limitation of motion	Ulna: End prominent. Carpus: Displaced forward	Slightly dwarfed; slight genu varum and flatfoot, left	—	—
47.	Solberg 1906	40 M.	—	15	—	Older brother of above	Right	No pain	—	Carpus: Displaced forward	—	—	—
48.	Phollet 1906	12 F.	Shoppirl	8	—	—	Bilateral	Pain in beginning	Extension limited	Radius: Lower third bowed forward. Ulna: Dislocated backward. Carpus and hand: Displaced forward. Roentgenogram	—	Orthopedic apparatus	Course: 4 yrs. No improvement
49.	Schade 1906	8 F.	—	—	No history of trauma	—	Bilateral, especially the right	No pain	Extension limited; abduction impossible; flexion increased	Radius: Lower third bowed forward and inward. Ulna: Dislocated backward on radius and carpus. Hand and wrist: Displaced forward, in normal relation to radius. Roentgenogram	Slight rotary and scoliosis	—	—
50.	Putti 1906	15 F.	Housework; washing	—	No history of trauma	—	Left	All movements painful	Extension limited	Radius: Lower third bent forward and inward. Ulna: Dislocated back and bent slightly forward. Carpus: Displaced forward, in normal relation to radius. Roentgenogram	Cubitus valgus	Oblique linear osteotomy. Plaster enlacement	Course: 1 yr. Good result
51.	Sauer 1906	F.	Servant	Childhood	No history of trauma	Several sisters and brothers said to have similarly deformed wrists	Bilateral	No pain	Extension limited 13"; abduction almost gone; flexion and adduction increased	Radius: Lower half bowed forward and toward ulna, especially at the epiphysis; shortened; interosseous crest prominent. Ulna: Displaced backward. Carpus and hand: Displaced forward with radius. Roentgenogram	Hyperostosis of the head of the ulna. Punal chest	Avoidance of forced flexion. Exercise	Deformity irreducible
52.	Sauer 1906	18 F.	Servant	—	No history of trauma	—	Left	Easily tired, especially in wringing wash	Extension diminished; flexion increased	Radius: Normal (?) with broadening of the epiphyseal line. Ulna: Dislocated backward. Carpus and hand: Displaced forward along with the radius	Pes planus, and bilateral genu varum	—	Course: 1 yr.
53.	Sauer 1906	20 F.	Servant	—	—	—	Left	Pain when doing hard work	No disturbance of motion	Radius: Bowed forward at lower end, toward ulna. Ulna: Dislocated backward. Carpus and hand: Displaced forward in normal relation to radius. Roentgenogram	—	—	—
54.	Stiada 1907	F.	—	—	—	—	—	—	—	Radius: Bowed forward. Carpus and hand: Subluxated forward. Roentgenogram	—	—	—
55.	Lenormant 1907	13 F.	—	Early childhood	Rheumatism at 8 yrs. No trauma or rickets	—	Right	Pain and weakness	Extension limited; flexion increased	Radius: Shortened; lower fourth bowed forward, deviating the joint surface. Ulna: Dislocated backward. Hand and wrist: Displaced forward with the radius. Roentgenogram	Dorsal scoliosis. Depression of zyphoid cartilage	Osteotomy of the radius	Good result
56.	Pels-Leusden 1907	Servant	14	Hard work	—	—	Bilateral, especially the right	Pain, especially in right wrist	Slight diminution of extension and abduction	Radius: Forward and medial bowing, with deviation of joint surfaces; right radius shorter than left. Ulna: Dislocated backward. Carpus and hand: Displaced forward. Roentgenogram	—	—	—
57.	Pels-Leusden 1907	20 F.	—	12	—	—	Bilateral	—	Motion limited	Radius: Bowed forward and toward ulna with deviation of the joint surface. Epiphyseal lines unfused (20 yrs.). Ulna: Displaced backward. Roentgenogram	Exostosis of radius proximal to epiphysis	—	—
58.	Etor 1907	F.	—	Birth	No history of trauma	Father has similar deformity	Bilateral, especially the right	—	No disturbance of motion	Radius: Bowed slightly inward and markedly forward. Ulna: Dislocated backward on radius and carpus. Lower fourth bowed outward and backward. Carpus and hand: Displaced forward. Os magnum prominent. Roentgenogram	—	Ulna can be reduced by strong pressure	Recurrence
59.	Peckham 1907	17 F.	—	14	—	—	Bilateral	—	—	Radius: Bowed forward. Ulna: Dislocated backward. Carpus and hand: Displaced forward. Roentgenogram	—	Open reduction by dissecting out intervening fibrous tissue at wrist	Improved
60.	Siegrist 1908	18 F.	—	11	No trauma or heavy work. Plays piano. No rickets	Maternal grandmother, mother and two sisters have similar deformities	Bilateral, more marked on left	Pain at onset of the deformity	Flexion, extension, adduction and supination diminished, especially on the left	Radius: Bowing of the shaft forward and inward, especially at the lower end. Ulna: Displaced backward. Carpus and hand: Displaced forward and toward ulna. First row of carpal bones wedge-shaped. Roentgenogram	Exostosis of left radius. Dorsal scoliosis. Pes valgus	Orthopedic appliance	No improvement
61.	Siegrist 1908	20 F.	Salesgirl	14	No history of trauma or heavy work	Sister of above and grandmother have similar deformities	Bilateral, more marked on left	Severe pain until height of deformity was reached	Extension limited and flexion increased	Radius: Moderate forward bowing of the entire shaft. Ulna: Dislocated backward. Carpus and hand: Displaced forward. Roentgenogram	Scoliosis and left pes planovalgus	—	—
62.	Siegrist 1908	44 F.	Washwoman	10-12	No history of trauma or heavy work	Mother of above two cases	Bilateral, especially the right	Severe pain at beginning, and on certain movements	All movements somewhat limited	Radius: Shaft shortened and bowed forward and inward at the lower end; deviation of the joint surface on two axes. Ulna: Dislocated backward. Carpus and hand: Forward. Roentgenogram	—	—	—
63.	Franko (Müller) 1908	37 F.	—	Early childhood	History of rickets as a child	—	Bilateral	No pain	Extension and abduction limited	Radius: Bowed toward ulna at middle, and forward at lower end; shortened; has exostosis. Ulna: Displaced backward, shortened. Carpus and hand: Displaced forward. Angulation of the first row of carpal bones, second row extended. Roentgenogram	Dwarfism. Exostosis tibia and fibula. Rotary	Neurosy Dissection	—
64.	Brinsmade 1908	15 F.	—	12	Arms twisted in childhood	—	Bilateral, more right	—	—	Radius: Lower end bowed forward and lower half bowed toward ulna. Ulna: Displaced backward. Carpus and hand: Forward. Roentgenogram	Slight scoliosis. Tibial bowing	—	Course: 1½ yrs.

TABULATION OF ANALYSES OF RELEVANT DATA OF 171 CASES OF TRUE MADELUNG'S DEFORMITY (Continued)

No.	Author and Year	Age and Sex	Occupation	Age at Onset	Casual Relationship	Hereditary	Unilateral or Bilateral	Wrist Joint		Examination	Other Abnormalities	Treatment	Course or Result
								Symptoms	Function				
64.	Stetten 1908	F.	Schoolgirl	11½	No rickets. History of fall after onset of the deformity	Mother presents prominent ulnar	Bilateral, more marked on the left	Slight pain on the right side	Flexion diminished; abduction almost nil on left, restricted on right; extension and pronation increased; supination and supination limited	Radius: Lower half bowed backward and toward ulna, shortened. Ulna: Dislocated forward with exaggeration of forward curvature; shortened. Carpus and hand. Displaced backward and toward ulna. Angulation of the first row of carpal bones. Roentgenogram	Exostosis of left radius	—	—
65.	Dupucé et Babere 1908	M.	—	10	Spontaneous	—	Bilateral	No pain	Extension is limited. Flexion is exaggerated	Ulna: Prominence of the heads at the back of the wrist. Radius: Anterior curvature of the distal ends. Hands and carpus: Anterior displacement. Roentgenogram	—	Radio-ulnar luxation, reducible on pressure	Recurrence
66.	Marzan 1908	M.	Joiner and carriage-maker	16	Hard work as a boy. No signs of rickets	—	Bilateral, more marked on left	Pain very severe at onset, still present on forced motion. Weakness	Flexion good. Extension zero. Pronation and supination limited	Ulna: Swelling at back of wrist due to luxation of ulnar head from radius and carpus. Hand and carpus: Apparent anterior displacement. Radius: Shortened, bowed anteriorly. Roentgenogram	Tuberculous arthritis of left ankle	—	—
67.	Peckam and Hammond 1909	M.	—	11	No history of trauma. No signs of rickets	—	Bilateral, less marked on left	Weakness of grasp. Difficulty in writing	—	Unusual prominence of the styloid process of the right ulna. Wrist and hand seem to be displaced backward on the forearm	—	Vibration to flexor muscles of the forearm	Restoration of muscular power. No change in degree of deformity
68.	Robinson et Jacquelin 1909	F.	Nurse	3	No rickets. Fall on left hand at age 7	—	Left	Muscular weakness. No pain	Extension, pronation and supination diminished. Flexion increased past right-angle	Left arm shorter than right. Swelling at the back of the wrist due to head of ulna which is luxated backward from the radius and carpus. Anterior curvature of the radius and apparent anterior displacement of the hand. Roentgenogram	—	—	—
69.	Robinson et Jacquelin 1909	F.	—	?	—	—	Left	Cadaveric Dissection		Ulna: Posterior projection of the head at the back of the wrist. Radius: Anterior curvature	—	Cadaveric Dissection	
70.	MacLennan 1909	F.	—	13	Unassociated with stress or strain	—	Bilateral	Slight ache after heavy work	Decreased extension, balanced by an increase in flexion	Ulna: Lower end prominent. Radius: Curved laterally. Both forearms comparatively shortened	—	Cuneiform osteotomy	Good
71.	Palazzi 1909	F.	Farmhand	3	No history of trauma. Hard work	—	Bilateral, especially the right	At onset, pain on hard work; then continual	Extension and abduction nil. Adduction diminished. Flexion increased	Apparent anterior dislocation at wrists. Dislocation at the lower radio-ulnar joint; reducible but returns on release of pressure. Radius: Bowed anteriorly. Left arm shortened. Roentgenogram	Left leg shorter than right. Right cubitus valgus	Osteotomy of the radius	Very satisfactory
72.	Putti 1909	Adult F.	—	Congenital	—	—	Bilateral	Museum Dissection Specimen. Discovered in Institute of Pathologic Anatomy, University of Bologna		(Plaster model): Prominence of ulnar head at back of wrist. Anterior curvature of the radius and anterior displacement of the carpus and hand. Roentgenogram	Museum Dissection Specimen		
73.	Gaudier 1909	F.	Schoolgirl	13	No history of trauma or of hard work	—	Bilateral	Wrist movements are clumsy and slightly painful	Movements clumsy	Shortening of both forearms. Ulna: Head palpable below palm of hand, dislocated anteriorly from the radius. Radius: Bowed laterally with a slight posterior curvature. There is "pyramidalization" of the carpal bones. Roentgenogram	Clubfoot, left. Compensatory pelvic deformity and scoliosis. Bilateral genu valgum and genu recurvatum	Luxation of ulna is reducible	Deformity recurs on release of pressure
74.	Ewald 1909	F.	Masseuse	Youth	No history of trauma	—	Bilateral	No pain	Extension limited 90° Supination impossible	Dislocation of the ulna, overriding the carpus superiorly. Hand and arm show a bayonet-shaped deformity. "Pyramidalization" of the carpal bones. Slight anterior bowing of the radius with normal relation to carpus. Roentgenogram	—	—	—
75.	Gaugele 1909	F.	Governess	15	Fell from wagon at age 9. No trauma to wrist	—	Right	Pain in right wrist on washing	All motions limited. Extension, supination and pronation markedly decreased	Ulna: Slightly bowed; styloid process projects dorsally. Radius: Bowed anteriorly. Roentgenogram	—	—	—
76.	Gaugele 1909	F.	Seamstress	Infancy	No rickets. Carried heavy weights	—	Bilateral	Pain short time	No limitation	Prominence of the ulnar head due to backward dislocation, reducible. Moderate anterior bowing of both radii. Roentgenogram	—	—	—
77.	Gaugele 1909	M.	Weaver	Childhood	No rickets. No history of trauma	Father had similar deformities	Bilateral, mostly on left	Pain in wrists, especially at work	Motion normal on both sides	Prominence of the ulnar heads. Dislocation of the inferior radio-ulnar joint; hand and carpus displaced anteriorly, in normal relation to radius. Articular end of radius: Deviated anteriorly and inward. Roentgenogram	—	—	—
78.	Mauclair et Labadie-Lagrave 1909	—	—	2	History of trauma	—	—	—	—	Luxation of the inferior ulnar articulation from the radius and carpus. Radius: Anterior bowing, but normal carpal articulation retained. Roentgenogram	—	—	—
79.	Burnier et Neveux 1909	F.	Seamstress	3	Fall on wrist at age 3. No rickets or tuberculosis	—	Bilateral	Weakness of both hands. No pain	Flexion 90°; extension very limited	Ulna: Head has lost all connection with the wrist joint. Radius: Inferior extremity curved forward, taking the carpus and hand with it. There is no true luxation of the wrist. Roentgenogram	Subject to rheumatism and sciatica	Operative intervention refused	—
80.	Leriche 1909	M.	Hatter	14	Fracture of the right ulna in infancy	—	Bilateral, especially the right	Pain on working relieved by rest	No limitations	Ulna: "Enormous swelling" at the back of the wrist, due to backward dislocation of ulnar head. Right radius: Bowed anteriorly, the hand appears luxated forward, but retains normal relationship with radius. Roentgenogram	—	Osteotomy of the right radius proposed	—
81.	Stokes 1910	F.	Farmer	12	"Overtrained" both wrists at age 9	—	Bilateral	Pain in wrist on work or exercise	Limitation of extension; otherwise normal	Ulna: Marked prominence of the styloid process. Radius: Markedly bowed forward in lower third. Roentgenogram	—	—	—
82.	Stokes 1910	F.	—	—	No evidence of rickets	—	Bilateral	Pain on continuous use of wrist	Extension slightly limited	Ulna: Prominent styloid process at the back of the wrist, which overrides the carpus. Roentgenogram	Bowing of the tibiae	—	—
83.	Jacquelin 1910	M.	Soldier, then carpenter	18	Fractured left radius after onset of deformity. No trace of rickets. Hard work	—	Bilateral, more marked on the right	No pain; no weakness	No limitations	Ulna: Prominent head; with luxation of the inferior radio-ulnar joint. Radius: Anterior curvature, accentuated at the metaphysis. Apparent anterior subluxation of the hand, but the relation of the carpus to radius remains normal. Roentgenogram	Atrophic cirrhosis. Pulmonary tuberculosis	Osteotomy not deemed advisable	Course: 7 yrs. (Progress of deformity ceased at age 25)
84.	Jones 1911	F.	Housewife	12	No history of trauma, rickets or tuberculosis	—	Bilateral	Slight attacks of pain and weakness in both wrists	Flexion and abduction slightly diminished	Ulna: Styloid processes both very prominent at the back of the wrist. Well-marked, characteristic deformity of the wrist. Roentgenogram	Sarcoma of the elbow	Plaster encasement	—
85.	Springer 1911	F.	—	5	No history of trauma. No sign of rickets	—	Left	No pain at onset; later, pain severe	Extension and adduction markedly decreased. Flexion and abduction increased. Supination slightly decreased	Ulna: Prominence of the head at the back of the wrist. Radius: Anterior bowing, especially at the epiphysis. Ulna overrides the carpus. Deviation of the articular surface of the radius. Roentgenogram	Tuberculosis of the hip	See ref. 218 for operative interference, performed in 1913	—
86.	Springer 1911	F.	—	—	Blow to wrist 14 days previous	—	Right	Pain in right wrist on motion	—	Slight deformity of right hand. Radius: Slight anterior bowing at the region of the epiphysis and moderate lateral bowing of the distal epiphysis. Radio-ulnar dislocation. Hemiatrophy of the ulnar side of the radial epiphysis. Roentgenogram	—	See ref. 218 for operative interference, performed in 1913	—
87.	Springer 1911	F.	—	12	No evidence of rickets	—	Bilateral, mostly right	No pain	—	Radius: Marked anterior and lateral bowing. "Pyramidalization" of the carpal bones. Carpus and hand: Displaced anteriorly. Roentgenogram	Flat-chested. Hypertostosis of the ulnar styloid	See ref. 218 for operative interference, performed in 1913	—
88.	Codet-Boisse 1911	F.	Laundryironer	13	Hard work. No evidence of rickets	—	Bilateral, especially the right	Pain, increased at work. Tender to pressure	Extension limited to 35°. Pronation and supination limited	Ulna: Prominence of the heads. Radius: Bowed anteriorly, and toward ulna. Ulna dislocated from carpus. Roentgenogram	—	Rest	Pain decreased
89.	Brandes 1911	aged M.	Baker, then wood-cutter, then writer	18	No sign of rickets	—	Bilateral	Pain at work; later continuous	Extension and abduction decreased. Pronation and supination limited	Bayonet-shaped deformity of the hands. Ulna: Marked prominence of the heads. Radii: Anterior bowing. Roentgenogram	—	—	—
90.	Brandes 1911	F.	Domestic servant	11	No sign of rickets	Daughter of above	Bilateral	Pain in wrists during late stage	Extension decreased 50%. Abduction impossible. Supination and pronation decreased	Ulna: Prominence of distal ends. Shortening of both forearms. Anterior bowing, especially near the wrist. Roentgenogram	Small chest	Heat and massage. Bandage to prevent progression of deformity	Pain disappeared
91.	Brandes 1911	F.	—	6	No sign of rickets	Sister of above	Bilateral	No pain	—	Deformity similar to older sister's above, but not so marked. Roentgenogram	—	—	—
92.	Quadrone 1911	M.	Farmer	Birth	No history of trauma. No rickets	—	Bilateral	No pain, even on hard work	Slight limitation of extension, abduction, and abduction	Ulna: Symmetrical retroposition of the heads, with an apparent subluxation forward of the hands at the wrists. Radii: Lower ends bent forward and downward. Roentgenogram	—	—	—
93.	Ramos 1911	F.	Wealthy family	8	No history of trauma. Plays piano	—	Bilateral	—	—	Ulna: Prominence of the heads. Radii: Anterior curvature, most marked in their lower thirds. Roentgenogram	—	—	—
94.	Melchior 1912	F.	Farmhand	—	No sign of rickets	—	Bilateral	No pain	Flexion: R 60°, L 45°. Extension: R 95°, L 70°. Pronation and supination normal	Carpus: Displaced laterally (marked cubitus valgus). Both hands "fourchette" position. Ulna: Prominence of the lower ends. Radii: Lower ends bowed anteriorly, more marked on the right. Roentgenogram	Shortening of fourth and fifth metacarpals (brachydactylia) of both hands	—	—
95.	Magnus 1912	F.	—	13	No sign of rickets	Mother has deformity more marked	—	Pain in left wrist on hard work	Extension impossible. Abduction limited. Adduction normal	Bayonet-shaped deformity of the hand. Radius: Bowed anteriorly, and shortened. Ulna: Disarticulated from carpus and radius, and overrides the carpus dorsally. Roentgenogram	—	—	—
96.	Taylor 1912	F.	Schoolgirl	11	No history of trauma. No sign of rickets	—	Bilateral	Pain in wrists, especially on working	Extension markedly restricted. Pronation and supination limited	Ulna: Heads very prominent at the back of the wrist. Hand: Displaced anteriorly. Roentgenogram	—	Two stage cuneiform osteotomy. Plaster of paris splint	Free from pain or deformity. Excellent function
97.	Taylor 1912	F.	Schoolgirl	13	No trauma. No sign of rickets	—	Bilateral	Weakness. Pain over ulnar head	Motion nearly normal	Marked dorsal prominence of the lower end of the ulna	Slight scoliosis to the left	—	—
98.	Berg 1913	F.	Servant	17-18	No sign of rickets	—	Left	Tenderness on palpation. Pain on hard work	All movements decreased	Left wrist thickened. Radius: Shortening, with slight bowing of the distal epiphysis. Slight anterior displacement of the hand. Roentgenogram	—	Attempt at reduction and application of plaster encasement	Deformity found increased after 6 mos.
99.	Berg 1913	F.	Peasant	14	History of hard work. No sign of rickets	—	Right	Painful at onset and during hard work	Extension and abduction decreased. Flexion increased. Adduction and supination normal	Ulna: Prominence of head. Hand and carpus: Displaced anteriorly, but retains normal relation to the articular surface of the radius. Radius: Bowed anteriorly. Luxation of the inferior radio-ulnar joint. Roentgenogram	—	Two attempts at reduction	No improvement
100.	Finsl 1913	F.	—	—	—	—	Left	—	—	Radius: Obliteration of inner third of radial epiphysis; rotasion of joint surface down and inward. Ulna: Longer than radius, with subluxation of carpo-ulnar joint. Roentgenogram	Exostosis of left radius at epiphyseal line	—	—
101.	Adler 1914	F.	—	—	No trauma. No sign of rickets	—	Bilateral	No pain	Slight restriction of extension	Radius and ulna: Marked prominence posteriorly, especially the ulna. The wrists appear thick. Roentgenogram	—	—	—
102.	Parles 1915	F.	—	12	—	—	Right	Pain and tenderness of right wrist	Inability to extend wrist. Flexion more marked than normal	Ulna: Lower end projects posteriorly. Roentgenogram	—	Cuneiform osteotomy and Lams plate	Deformity corrected. No pain
103.	Earl 1916	F.	—	17	—	—	Bilateral	Pain in both wrists	—	Marked deformity of both wrists. General relaxation of all joint structures. Roentgenogram	Amenorrhoea. Infantile uterus	—	—
104.	Mauclair 1916	—	—	10	No trauma. No sign of rickets	—	Bilateral	Slight pain	Limitation of flexion and extension	Ulna: Head luxated backward from radius and carpus. Radius: Bowed forward carrying the carpus anteriorly and to the ulnar side	—	—	—
105.	Mauclair 1916	M.	—	—	Plays a lot of tennis	—	Bilateral	—	—	Ulna: Slight luxation of the head from the radius and wrist. Radius: Projection of the epiphysis forward. Hand and wrist: In normal relation to radius	—	—	—
106.	Mauclair 1916	F.	—	15	Plays violin. No sign of rickets	—	Bilateral, especially the right	—	—	Ulna: Posterior luxation. Radius: Lateral curvature. The epiphyseal line is irregular on the right, missing on the left. Roentgenogram	—	—	—
107.	Guye 1919	F.	—	11	Walked late. Frontal bossing. No other sign of rickets	—	Bilateral, more marked on left	No pain	Hypermotility of flexion and extension	Ulna: Luxation of the inferior articulation with prominence of the head at the back of the wrist. Radius: Anterior bowing. Apparent anterior subluxation of the hand. "Pyramidalization" of the carpal bones. Roentgenogram	—	—	—
108.	Pillate 1919	F.	Dairymaid	6	Fall on hands at age 6. No rickets	—	Bilateral, especially the left	No pain. Able to do hard work	—	Ulna: Prominence of the head at back of wrist. Radius: Lateral curvature of the head and an anterior curvature of the lower third. "Pyramidalization" of the carpal bones. Roentgenogram	Bilateral cubitus valgus	—	—
109.	Pillate 1919	F.	Housewife	11	No trauma. No rickets	Newborn child has absence of radius	Bilateral, especially the right	Easily fatigued. Pain from onset, even on light work	Flexion limited; extension, pronation and supination are normal	Ulna: Marked prominence of the head, showing posterior dislocation. Radius: Curved anteriorly and somewhat laterally. Carpus: In normal relationship to radial articulation. "Pyramidalization" of the bones of the wrist. Roentgenogram	—	—	—
110.	Pillate 1919	F.	Bottler	11	No trauma. No rickets	—	Bilateral	Pain during the first year only	Pronation and supination normal. Extension limited. Flexion exaggerated	Marked swelling at back of wrist at site of the ulnar head. Both forearms shortened. Radii: Bowed laterally and anteriorly. Hemiatrophy of ulnar half of radial epiphysis. Roentgenogram	—	—	—
111.	Gery et Colombier 1920	F.	Cook	30 (?)	No trauma or hard work. Kneads dough	—	Bilateral	—	Flexion and pronation diminished. Abduction practically nil	Ulna: Luxated lower end. Radius: Anterior curvature of the lower end, with moderate lateral curvature of the distal epiphysis. "Pyramidalization" of the bones of the carpus	Patient died of gastric carcinoma	Cadaveric Dissection	
112.	Gery et Colombier 1920	F.	Seamstress	3	No rickets	—	Bilateral	Slight pain	Little functional limitation	Ulna: Luxation of head, reducible on pressure. Radius: Slight bowing laterally, and anteriorly at the level of the epiphysis	—	—	—
113.	Wéry 1921	F.	—	14	—	Sister also has deformity	Bilateral	Pain first 2 yrs.	—	Radius: Double curvature of lower end anteriorly and laterally. Luxation of the inferior radio-ulnar joint and a pseudo-luxation of the hand and carpus. Roentgenogram	—	—	—
114.	Wéry 1921	F.	—	14	—	—	Bilateral	Pain during first 2 yrs.	—	Radius: Lower end bowed anteriorly and laterally. Ulna: Dislocated from radius. Apparent forward luxation of hand and carpus. Roentgenogram	—	—	—
115.	Masmontell 1921	M.	Student	14	No history of trauma	—	Left	Pain	Extension, abduction, and adduction zero. Pronation 90°; flexion 15°; supination 45°	Prominence of the head of the ulna. Palmar subluxation of the hand	—	Cuneiform osteotomy. Hand immobilized in hyperextension in a plaster encasement. Later reaction: head of ulna	Ethetically perfect. Pronation 180°; extension 80°; flexion 22°; abduction 20°; adduction 25°
116.	Mathieu et Joseph 1922	F.	Tile-maker	15	Carries heavy weights	—	Bilateral, especially the left	Left wrist is painful	All movements normal in amplitude	Hand and carpus: Apparent anterior dislocation anteriorly. Radius: Bowed anteriorly and laterally, with a thick exostosis about the middle on the ulnar side. Luxation of the inferior radio-ulnar articulation. Roentgenogram	Bilateral bowing of the lower third of the tibiae	Deformity reducible, but returns on release of pressure. Operation refused	—
117.	Mathieu et Joseph 1922	F.	Scholar	13	Does much writing	—	Bilateral	Pain in right wrist, especially on writing	Extension limited; all other movements are normal	Swelling ulnar side of dorsum of wrist. Luxation of the inferior radio-ulnar joint. Radius: Anterior curvature at the metaphysis. Hand and carpus: In normal relation to radius. Roentgenogram	—	Ulna shortened by osteotomy	Presumed that functional result will be excellent
118.	Brown 1923	F.	—	8	No evidence of rickets	—	Bilateral	Pain in wrist, especially on motion	Extension and abduction limited	Radii: Bowed with convexity posterior. Wrist: Apparently displaced forward. Roentgenogram	Bowing of both tibiae	—	Progressive
119.	Greig 1924	F.	—	Early childhood	—	—	Bilateral	No pain	No limitation of motion	Ulna: Distal end overlaps carpus dorsally. Apparent disjunction of the head of the ulna from radius and wrist joint. Forearm unusually short. Radius: Curved anteriorly. Roentgenogram	—	—	—
120.	Ianni 1924	F.	—	11-12	No trauma. No hard work	—	Left	Pain on playing piano. Free on movement	Extension limited. Abduction, supination and pronation slightly limited. Adduction increased. Flexion normal	Hand: Apparent forward dislocation. Ulna: Overrides the hand and causes a swelling at the base of the wrist. Radius: Anterior curvature of the lower third. Roentgenogram	—	Transverse linear osteotomy of the radius at age 13	Deformity cured and perfect function at wrist one month after operation

TABULATION OF ANALYSES OF RELEVANT DATA OF 171 CASES OF TRUE MADELUNG'S DEFORMITY (Continued)

No.	Author and Year	Age and Sex	Occupation	Age at Onset	Casual Relationship	Heredity	Unilateral or Bilateral	Wrist Joint		Examination	Other Abnormalities	Treatment	Course or Result
								Symptoms	Function				
121.	Levyn 1924	56 F.	Housewife	12	No history of trauma or rickets	Mother of patient below	Bilateral	No pain, but wrists are fatigued more easily than normal	Extension limited. Flexion increased	Shortening of radius and ulna with slight bowing of both bones. Pronounced backward displacement of ulna. Excavated, wedge-shaped appearance of articular surfaces of radius and ulna. Roentgenogram	—	Glandular therapy (thyroid, pituitary and antitoxin)	—
122.	Levyn 1924	18 F.	Student	12	No rickets or trauma. Played piano a lot	Daughter of above	Bilateral	No pain. Slight exertion produces fatigue	Extension limited. Flexion increased	Bowing of radius not so marked as above. Excavated, wedge-shaped articular surfaces. Roentgenogram	—	Glandular therapy (thyroid, pituitary and antitoxin)	Increase in length of ulna. No change in deformity
123.	Moore 1924	16 F.	Typist; plays piano	14	No history of trauma or hard work	—	Left	Pain in wrist	Extension limited. Flexion unusually free	Left hand. Displaced forward. Ulna; Head very prominent. Radius: Lower fourth bowed forward. Roentgenogram	—	Cuneiform osteotomy. Plaster encasement, in extension	Deformity corrected; extension increased; flexion now normal
124.	Moore 1924	15 M.	—	13	Patient boxed a great deal	—	Left	Pain in wrist	Extension limited. Flexion unusually free	Ulna: Marked backward projection of the head. Radius: Some forward curvature. Hand: Deviated to ulnar side. Roentgenogram	—	Resection of the head of the ulna. Sutured lower end of ulna to carpus	Good
125.	Defne 1924	13½ F.	Weaver; plus housework	12	Hard, exhausting work. No trauma or rickets. Positive Wassermann	Luetic	Bilateral	Intermittent pain in wrists and forearms, aggravated by motion. Weakness of wrists	Extension diminished and painful. Supination and adduction decreased. Pronation and flexion normal	Swelling at the back of the wrist with apparent anterior displacement of the hand. Radius: Anterior curvature, with atrophy of the ulnar side of the epiphysis. Inferior ulnar articulation luxated from radius and carpus. Roentgenogram	—	Massage, active and passive motion. Osteotomy considered and will be performed at proper time	—
126.	Garrido-Lestache 1925	13 M.	Field-hand	11	—	—	Right	No severe pain. Weakness of right wrist	Extension limited. Flexion augmented	Apparent anterior displacement of hand. Swelling of ulnar head at back of wrist. Radius: Anterior bowing. Roentgenogram	—	Immobilization and rest	—
127.	Llaro and Gallardo 1925	14 F.	—	13	—	—	Bilateral, especially the right	Fatigue in the right wrist	Extension, adduction and supination limited on right side	Carpus: Apparent anterior luxation. Ulna: Prominence of the head at the back of the wrist. Radii: Anterior bowing. Roentgenogram	—	—	—
128.	Merini 1925	25 F.	Housework	11	No history of trauma. No evidence of rickets	—	Bilateral	Continuous, vague pain in the wrists during course of disease	Extension and abduction reduced. Pronation and supination not modified. Flexion and adduction more than normal	Ulnae: Marked prominence of heads. Forearms: Shortened. Radii: Anterior and lateral bowing of shafts. Dehiscence of the inferior radio-ulnar articulation. Hand and carpus: Displaced anteriorly, in normal relation to the articulating surface of the radius. Roentgenogram	—	—	—
129.	Mazzini 1925	17 F.	Servant	7	No evidence of rickets.	—	Bilateral, especially the right	Pain on hard work, relieved by rest	Left side normal. Right: Abduction and adduction restricted. Extension zero	Ulna: Prominence of the head. Forearms: Marked shortening. Radius: Anterior bowing. Roentgenogram	—	—	—
130.	DeBernardi 1925	10 F.	—	4	No history of trauma	—	Left	Pain on onset and on palpation	Flexion increased. Extension limited	Left forearm shortened, deformity at the back of the wrist. Luxation of the inferior radio-ulnar joint. Epiphysis of the radius turned anteriorly. Hand displaced forward, in normal relation to the articulating surface of the radius. Roentgenogram	—	—	Course: 18 mos.
131.	DeBernardi 1925	8 F.	Schoolgirl	3	No trauma. No evidence of rickets	—	Right	Pain on onset. Stabbing pain on motion	Extension nil. Abduction limited	Swelling at the back of the wrist. Radii: Bowed anteriorly at the region of the epiphysis. Hand: Displaced anteriorly. Roentgenogram	—	—	—
132.	Jösa 1926	17 M.	Apprentice blacksmith	14	Hard work	Orphan; no recollection of family	Bilateral, especially the left	Slight pain at onset relieved by work	Extension: R. 48°; L. 35°. Flexion: R. 78°; L. 40°. Adduction: R. 40°; L. 26°. Abduction: R. 10°; L. 20°. Supination normal	Hands: Bayonet-shaped deformity. Ulnae: Prominence of the heads. Radius: Shorter than ulna, more marked on the left side. Roentgenogram	Scoliosis and genu valgum. Inguinal hernia	—	—
133.	Catterina 1926	33 F.	Servant	Childhood	—	—	Bilateral	No pain in the wrists	Extension limited. Flexion and adduction increased	Radii: Marked anterior and lateral curvature of the lower third, with moderate curvature of the upper two-thirds. Ulna: Slightly bowed forward, heads prominent at back of wrist. Hand: Displaced forward. Roentgenogram	—	—	—
134.	Pedraza 1927	12 F.	Schoolgirl	8	No trauma. Possible rickets	Mother and younger sister have similar deformities	Bilateral, especially the left	Pain on grasping, writing, sewing, and hard work	Extension difficult. Flexion easy. Marked limitation of abduction and adduction	Swelling at the back of the left wrist. Apparent anterior dislocation of the wrist. Radii: Bowed anteriorly. Left arm shortened. Roentgenogram	Patient quite small in size for her age	—	—
135.	Pedraza 1927	15 F.	—	11	Possible rickets. Plays piano. No trauma	Sister of above	Bilateral, especially the right	More or less continual pain	Flexion easy. Extension difficult. Adduction and abduction about normal	Ulna: Styloid prominent on right side. Radii: Curved laterally and anteriorly. Hand: Displaced forward. Roentgenogram	Patient quite small in size for her age	—	—
136.	Pocchini 1927	20 M.	Shoemaker	11	No history of trauma. No sign of rickets	—	Bilateral, especially the left	Pain on working	—	Swelling on ulnar side of back of wrists. Dislocation of the inferior radio-ulnar joint. Radius: Anterior curvature, most marked in the lower third. "Fork" hand deformity, with anterior displacement of the hand. Roentgenogram	—	—	—
137.	Tollas 1927	16 F.	—	11	—	—	Bilateral, right more than left	Pain from onset, with gradual increase during progression of the deformity	Extension: R. 45°; L. 50°. Flexion: R. 90°; L. 90°. On both sides: Pronation normal; supination decreased; abduction 45°; adduction 10°	Ulna: Prominence of the heads. Carpus: Apparent anterior luxation. Bilateral cubitus valgus, right: 35°, left: 30°. Roentgenogram	—	—	—
138.	Roederer 1928	30 F.	Domestic servant	Puberty	—	—	Bilateral	Weakness, clumsiness; unable to do hard work	Extension slightly limited. Flexion and pronation normal	Ulna: Abnormal swelling of the head above the wrist, reducible on pressure. Subluxation of the ulna from the radius and carpus. Radius: Anterior bowing at the metaphysis. Roentgenogram	Patient very small in size	Deformity reduced by pressure, and held in place by wrist band	Relief of pain for 3 mos.
139.	Bertoletti 1928	23 F.	Peasant	18-19	Hard work. No evidence of rickets	—	Bilateral, especially the right	Pain on motion and change of weather	Limitation of extension and abduction. Increase of flexion and adduction	Ulna: Bilateral prominence of the head, especially on the right. Radii: A moderate lateral anterior curvature, bending the articular surfaces down and inward. Hands: Displaced forward	—	Operative interference not deemed justifiable	Course: 4 yrs. Deformity still present, pain less
140.	Félix 1928	16 F.	Handworker	15½	No history of trauma. No rickets	—	Bilateral	Pain in both wrists	Extension 20°; flexion 80°-90°; supination decreased; adduction less	Bayonet-shaped deformity of wrist. Ulna: Prominence of the heads. Radii: Marked anterior bowing; the ulnar third of the lower epiphysis is missing. Roentgenogram	Exostosis of both ulnae near epiphyseal line	—	—
141.	Schnek 1928	18 M.	—	10	No history of trauma. No rickets	—	Right	Right hand weak. No pain	Right hand: Extension and abduction nil	Right forearm shorter than left. Carpus: Subluxated anteriorly. Radius: 5 cm. shorter than ulna. Roentgenogram	Small in stature	Triangular osteotomy of the ulnar head. Resection of the ulnar head. Plaster encasement, with hand fixed in extension	Three mos. later: Good function and all movements present
142.	Schnek 1928	36 F.	—	Youth	Fracture of radius at age 2; badly set	—	Bilateral	Pain on making a fist	Flexion 85°; extension 20°; abduction 25°; adduction none	Radii: Anterior bowing. Forearms: Shortened. Carpus: Subluxated; more marked on right	—	Osteotomy and resection as above	—
143.	Vidal 1929	45 F.	Servant	Infancy	Hard work. No trauma	Mother, two sisters and a niece have similar deformities	Bilateral	No pain. Able to do hard work	Flexion 80°-90°; extension 45°; abduction limited; adduction augmented. Pronation and supination normal	Ulna: Prominence of the head. Dislocation of the inferior radio-ulnar joint. Hand and carpus: Apparent anterior displacement. Radius: Lower fourth is curved laterally and anteriorly. Roentgenogram	Bilateral, pulmonary tuberculosis	—	—
144.	Vidal 1929	50 F.	Cook	Infancy	No history	Sister of above	Bilateral	Pain on exaggerated motion of wrists	Extension 45°. Flexion 80°-90°. Abduction limited. Adduction increased. Pronation and supination normal	Ulna: Head projects over the carpus. Radii: Lower third curved anteriorly. Hand and carpus: Displaced forward, in normal relationship to the radius. Roentgenogram	—	—	—
145.	Fazio 1930	14 F.	—	12	No history of trauma. No rickets	—	Bilateral, especially the right	Pain at onset	Active motion present	Radii: Slight anterior curvature at the region of the epiphysis, and slight lateral curvature of the shaft. Hand and carpus: Anterior displacement. Roentgenogram	Slight of stature	Oblique linear osteotomy. Application of plaster encasement	"Cured"
146.	Rocher et Roudil 1930	24 M.	—	7	No history of trauma	—	Bilateral	No trouble except on hard work	Hands held in fixed position. Supination impossible. Extension and flexion normal	Ulnae: Prominence of the heads, due to luxation from the inferior end of the radius. Radius: Lateral bowing of the diaphysis and anterior bending at the epiphysis. Hemistrophy of the epiphysis on the ulnar side. Roentgenogram	—	—	—
147.	Cesery-Pechany 1930	18 F.	—	12	Irregular menses. No evidence of rickets	—	Bilateral	—	—	Dislocation of the inferior radio-ulnar articulations. Radii: Bowed anteriorly and laterally. Hemistrophy of the inner half of the inferior radial epiphysis. Roentgenogram	—	Ovarian and glandular hormone therapy for 7 mos.	Course ceased, Roentgenogram "evidence" of improvement of the deformity
148.	Gaszotti 1931	18 F.	Ironer (presser)	14	No trauma. No rickets.	—	Bilateral	Slight pain on all movements	Extension and abduction reduced. Pronation and supination limited. Adduction and flexion increased over normal	Radii: Bilateral anterior and lateral bowing. Ulnae: Over the carpus displaced anteriorly. Radii: Displaced anteriorly in normal relation to radius. Roentgenogram	—	Oblique osteotomy and application of plaster encasement	Very good. Ten mos. later all movements present and deformity cured
149.	Tancredi 1931	15 F.	—	11	Menses irregular	—	Bilateral	—	Supination impossible. Extension, abduction, adduction and pronation limited. Flexion increased	Radii: Anterior curvature, especially in the distal fourth. Ulnae: Heads project dorsally. Hands: Displaced anteriorly. Roentgenogram	Legs and arms are short compared to trunk	Transverse osteotomy with correction of plaster encasement	Perfect result functionally and morphologically
150.	Vianna 1931	13 F.	—	11	—	—	Bilateral	Pain—first during day, then continuous	Abduction, adduction, pronation and supination limited. Extension nil. Flexion increased	Wrist: Bayonet-shaped deformity, with prominence of the ulnar heads. Radius: Anterior bowing, especially in the lower third. Dislocation of the inferior radio-ulnar articulation. Roentgenogram	Spina bifida occulta of the lower cervical and upper thoracic vertebrae	Transverse osteotomy with correction of deformity, first right, then left	"Brilliant"
151.	Fick und Pahl 1931	21 F.	Servant	19	No rickets	—	Right (beginning on left?)	Work produces pain and fatigue	Marked limitation of extension and flexion. Abduction normal	Ulna: Prominence of the distal end. Carpus: Anterior subluxation. Radius: Marked lateral and slight anterior bowing. Roentgenogram	—	—	—
152.	Salisachs 1933	16 M.	Student	Infancy	—	—	Bilateral, especially the right	Slight pain over lower third of radius	Limitation of extension	Subluxation of the inferior radio-ulnar joint. Radius: Anterior curvature. Ulna: Head prominent. Roentgenogram	Hyperostosis of ulnar epiphysis	Immobilization in splint	—
153.	Salisachs 1933	13 F.	—	Infancy	Hard work for 4 to 5 yrs.	Father has similar deformity	Bilateral, especially the right	No discomfort	Extension, pronation and supination limited. Abduction impossible. Flexion exaggerated	Ulnae: Prominence of heads. Radii: Lateral curvature	Kyphosis	—	—
154.	Salisachs 1933	25 M.	Writer	—	—	—	Bilateral, especially the right	No pain	Extension slightly limited. Contracture of flexors limits other movements	Hands: Apparent marked anterior displacement. Radii: Anterior and lateral bowing, most marked in the lower half. Roentgenogram	Cystic areas noted throughout the skeletal system	—	—
155.	Kun 1933	14 F.	—	13	History of extreme effort, but after onset	—	Bilateral, especially the left	Pain in both wrists	Extension and supination limited. Flexion augmented	Ulnae: Posterior luxation of the inferior radio-ulnar joint. Anterior curvature of entire shafts, especially at the distal end. "Pyramidalization" of the carpal bones. Roentgenogram	Spina bifida occulta of the lumbar vertebrae. Psoas valvulus. Genu valgum	Plaster encasement applied, with hand in extension. Osteotomy considered for later date	Encasement removed because of pain. No improvement
156.	Maasbauw, Solas et Niche 1934	— F.	—	11	No evidence of rickets	History of similar deformity in father	Bilateral	Pain on prolonged use of hand in writing	Diminished extension and supination	Ulna: Prominence of head. Radius: Anterior bowing. Carpus: Apparent anterior luxation. Roentgenogram	—	No operative interference	Course: 3 yrs.
157.	Kajon 1934	7 M.	—	7	No history of trauma. No rickets	—	Right	No pain	Extension slightly exaggerated. Abduction decreased	Right forearm: Shorter than left. Radius: Bowing, and widening of the epiphysis. Roentgenogram	Cervical rib	—	—
158.	Rocher et Rocher 1934	57 F.	—	Childhood	—	—	Bilateral, especially the right	No pain	No limitation of motion	Ulnae: Slight prominence of the heads at the back of the wrists. Dislocation of the inferior radio-ulnar joint. Radii: Slight anterior bowing of the radius at the epiphysis. Roentgenogram	Absence of the right caput humerus, and maldevelopment of the tuberosity	—	—
159.	Canton 1935	23 M.	—	Childhood	No history of trauma	—	Bilateral	No pain	Hands held in fixed position. Supination impossible. Extension and flexion normal	Ulna: Prominence of the head at the back of the wrists. Radius: Shaft bowed laterally, and anteriorly at the distal extremity. Roentgenogram	—	—	—
160.	Barsom 1935	12 F.	—	11	—	—	Bilateral	Pain on extremes of motion. Weakness of wrist	"Abnormal" motility of both wrist joints	Hands and carpus: Symmetrical volar displacement. Radii: Abnormal curvature, with thickening at the distal end. Roentgenogram	—	—	—
161.	Beder und Heimsann 1935	25 F.	Factory worker	12-13	Amenorrhoea. No development of breast	—	Bilateral	Pain in radiocarpal joint. General weakness	Limitation of extension	Ulna: Styloid prominent and projects dorsally. Radius: Bowed forward. Hand and carpus: Displaced anteriorly. Roentgenogram	Male configuration. Deformity upper tibial epiphysis	Suggests endocrine therapy	—
162.	Beder und Heimsann 1935	28 F.	—	14	Oligomenorrhoea	—	Bilateral	—	—	Deformity of radiocarpal joint as above. Roentgenogram	—	—	—
163.	Landivar y Iparaguire 1936	61 M.	Barrendero	51 (?)	No evidence of rickets	—	Bilateral	No pain or discomfort	Extension 35°; flexion 90°. Adduction 50°; abduction 10°. Pronation and supination 30°	Radii: Anterior bowing. Separation of radio-ulnar articulation. Carpus: Anterior subluxation. Roentgenogram	Rarefied areas in left ileum, pubis and ischial tuberosity	—	—
164.	Chierici 1936	15 F.	—	13½	—	—	Bilateral	Weakness	Pronation, supination and extension limited. Flexion exaggerated. Marked limitation of abduction; slight limitation of adduction	Ulnae: Prominence of heads at back of wrists. Radii: Anterior curvature in the lower third, most marked at the metaphysis. Lateral bowing of the lower fourth. Hands: Displaced forward, but in normal relation to the articular surface of the radius. Roentgenogram	—	—	—
165.	Chierici 1936	13 F.	—	12	Spontaneous	—	Bilateral	—	Extension and abduction limited. Adduction slightly limited. Flexion to 90°	Ulna: Abnormal swelling at the back of the wrist due to head of the ulna. Radius: Anterior curvature at the metaphysis. Hand and wrist: Anterior displacement, in normal relation to the radius. Roentgenogram	Curvature of both tibiae	—	—
166.	Claiborne and Kuntz 1936	16 F.	—	9	—	—	Bilateral, more marked on right	Pain in wrist, especially on motion	Extension and abduction limited	Ulnae: Heads prominent. Radii: Bowed (with the convexity) dorsally, and laterally. Carpus: Apparent dislocated anteriorly. Roentgenogram	—	—	—
167.	Roudil, Devron, et Mourgues 1936	14½ F.	—	10½	Nostigmata of rickets. No history of trauma	—	Bilateral	Pain especially on motion. Weakness of wrists	Supination 40°; pronation 70°; flexion 90°; extension normal; abduction 10°; adduction 30°	Ulna: Luxation of the inferior end from the radius and carpus. Forearms: Shortened. Radii: Lower third bowed anteriorly; moderate lateral bowing of the shaft. Hand and carpus: Displaced anteriorly, in normal relation to the radius. "Pyramidalization" of the carpal bones. Roentgenogram	Bilateral cubitus valgus	—	—
168.	Rocher 1937	13½ M.	—	9	No history of trauma. No rickets	—	Bilateral, more marked on right	"Growing" pain in wrists and knees	Flexion: R. 80°; L. 90°. Extension: R. 0°; L. 40°. Abduction: R. 0°; L. 20°. Adduction: R. 15°; L. 25°. Pronation normal on effort	Ulna: Projection of head at the back of the wrist. Radius: Marked anterior curvature, curving the head forward. No luxation of the wrist from the radius, but the radius is dislocated from the ulna. "Pyramidalization" of the carpal bones. Roentgenogram	Dischondroplasia of the os centrale of the wrist	—	—
169.	Burrows 1937	14 M.	Schoolboy and junior clerk	8	Sprained right wrist at age 2	—	Right	—	Extension full. Abduction increased. Adduction negligible. Flexion limited to 90°. Supination limited	Ulna: Head of the ulna projects below the level of the radius. Characteristic silver-fork deformity of the "reverse" type of Madelung's. Hand and carpus: Displaced backward. Roentgenogram	—	Excision of the ulnar head. Linear osteotomy. Plaster encasement	Functional improvement
170.	Burrows 1937	17 M.	Warehouseman	16	—	—	Right	Pain, worse after work	—	Ulna: Lower end prominent at the back of the wrist. Radius: Bowed anteriorly. Hand: Displaced forward. Roentgenogram	—	Operation as above	Correction good. Motion normal. No shortening
171.	Anton, Reitz, and Spiegel 1938	18 F.	—	15	Hit by auto at age 0; no trauma to wrists	—	Bilateral	Pain in both wrists	All movements, especially extension and abduction, limited. (See case history for details)	Forearms: Shortened. Ulnae: Heads project at back of wrists. Radii: Bowed anteriorly at the region of the metaphysis, with moderate lateral curvature of the shaft. Hands: Displaced forward. "Pyramidalization" of the carpal bones. Roentgenogram	Increased digital impressions of the inner table of the cranial vault	Rest. To return for osteotomy	—

SUPPLEMENT

to the Article by

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and

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on

MADELUNG'S DEFORMITY

A Tabulation of 171 Case Reports

MADELUNG'S DEFORMITY

and B), as if the hands had been dislocated anteriorly. There is also an obvious shortening of both forearms (left—eight and one-quarter inches long; right—eight and one-half inches long). A lateral view of the forearm and hand roughly resembles a bayonet (Fig. 1 A). There is a marked swelling at the back of the wrist which palpation determined as being the head of the ulna and which, apparently, overrode the carpus superiorly. Palpation of the lower end of the radius reveals a definite forward bowing with convexity on the dorsal surface, and a moderate lateral bowing with the concavity toward the ulna. This bowing has displaced the carpus and hand forward and to the ulnar side. The flexor tendons are slightly more prominent than usual. Measurements of the forearms show:

	Right	Left
Radius (from the head to the styloid process).....	18 cm.	18½ cm.
Ulna (from olecranon to styloid process).....	20½ cm.	22 cm.
Hand and forearm (olecranon to tip fifth finger).....	32 cm.	33 cm.
Circumference of wrist (at styloid process).....	16 cm.	16 cm.
Thickness of wrist (at styloid process).....	4 cm.	4¼ cm.
Breadth of wrist (at styloid process).....	5.8 cm.	6½ cm.
Humerus (from acromion to external condyle).....	29½ cm.	29½ cm.

There is to be noted a decided shortening of the radius (from a normal of approximately 22 cm.) of 4 cm. on the right, and 3½ cm. on the left, and also a shortening of the ulna (from a normal of approximately 25 cm.) of 4 cm. on the right, and 3 cm. on the left. Motion is the same either active or passive, and is somewhat painful at the extremes. Mobility at the wrist is only slightly affected, and, although the deformity is clinically symmetrical, the right side is affected more than the left. The limit of motion from a horizontal plane is estimated as:

	Right	Left
Flexion.....	90°	60°
Extension.....	30°	40°
Adduction.....	30°	40°
Abduction.....	25°	40°
Pronation and supination are within normal limits.		

During a short stay in the hospital for the purpose of observation, a laboratory study of the patient was carried out. Similar studies, partial or complete, have been made by Beder,¹⁰ Brown,²¹ Catterina,⁴⁰ Fazio,⁸⁰ Siegrist,²¹³ Stetten,²²¹ Tollas,²²⁷ and Vianna.²²¹ The results obtained by these investigations indicate that this condition is not manifested by any deviation of the body's chemical or biologic processes. The data acquired in the present instance tend to confirm that impression.

Laboratory Data.—Wassermann test negative. Basal metabolism minus four. Urinalysis: Color—yellow; 1,015; alkaline; albumin, sugar, blood and bile, all absent. Microscopic examination essentially negative. Hematology: R.B.C., 5,030,000; Hb., 90 per cent; W.B.C., 8,950. Differential: polymorphonuclears, 65 per cent, lymphocytes, 33 per cent, transitionals, 2 per cent; platelets, 210,000; fragility, 0.45 to 0.27; sedimentation time, 18 Mm. in one hour and 20 minutes.

Blood Chemistry

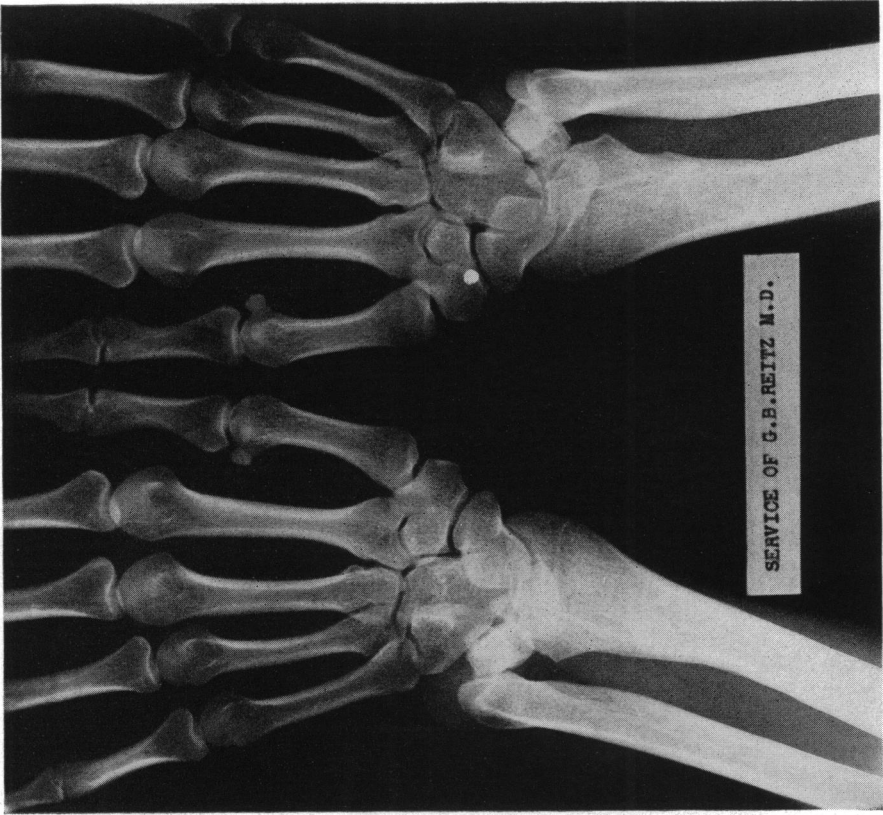
Urea nitrogen.....	12.9 mg.	Total cholesterol..	105.3 mg.
Sugar.....	88.9 mg.	Cholesterol ester..	65 per cent
Albumin.....	9.3 mg.	Calcium.....	10.5 mg.
Globulin.....	2.2 mg.	Phosphorus.....	4.8 mg.
Chlorides.....	625.0 mg.	Icteric index.....	3.8 mg.

van den Bergh: Direct and indirect—negative.



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FIG. 2.—Lateral roentgenogram of the wrist showing the anterior bowing of the radius, and the backward luxation of the head of the ulna.



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FIG. 3.—Anteroposterior roentgenogram of the wrist and carpus showing the "pyramidalization" of the carpal bones, the absence of the medial half of the epiphyseal line, and the rarefaction of the medial border of the lower end of the radius.

Roentgenologic Examination.—Dr. G. H. Koiransky: "There is a striking alteration in the relative lines of the radius and ulna on both sides, the tip of the ulna being on a definitely higher level than the styloid process of the radius. The epiphyseal line of the distal radial epiphysis is visualized on both sides only in its radial half, and instead of running transversely through the whole thickness of the radius, makes a sharp bend, almost at right-angles, in the cephalad direction. The articular surfaces of either radius, as visualized from lateral exposure, are definitely facing forward. The distal ulnar extremity is subluxated in the ulnar-dorsal direction. A small exostosis is noted on the ulnar aspect of the radius opposite the missing half of the epiphyseal line. The roentgenographic appearance is typical of the so-called Madélung's deformity" (Figs. 2, 3, and 4). A roentgenogram of the skull (Fig. 5) revealed: "The character of the digital impressions are very marked, considering the age of the patient, and assume the appearance of the so-called 'lückenschädel.' There is also evidence of a small amount of calcification in the region of the pineal body. The sella turcica is apparently normal in shape, size and appearance. Roentgenograms of the other long bones showed no abnormalities."

Because of the increased digital markings of the skull, it was desired to determine if there might be an increase of intracranial pressure. The patient, however, refused to submit to a spinal tap. Examination of the optic fundi did not reveal any papilledema.

In view of the fact that the patient presented no menstrual disorders, or any other evidence of a hormonal dyscrasia, it was not considered necessary to undertake the complicated determinations of the various sex hormones.

The patient was discharged and advised to return at a later date (on cessation of growth) for operative correction of the deformity.

PATHOLOGY.—The data considered in determining the pathology of this condition were obtained by reviewing the 171 cases tabulated herewith, which we have accepted as authentic examples of the deformity. To earlier investigators^{89, 115, 135, 158, 192} the opportunity for necropsy diagnosis presented itself, and served to dispel the idea that the deformity was a dislocation of the hand. In 1897, Jagot¹¹⁴ first appreciated the importance of the roentgenologic examination in determining the diagnosis and pathology of this condition, and this aspect has been progressively developed, as evidenced by the increasing prominence given it in literature.

A review of the published articles reveals that this deformity of the wrist may affect any, or all, of the various structures that go to make up the wrist joint, but it is the *radius*, especially its lower extremity, that is essentially the seat of the primary pathologic phenomenon which is in the nature of an osteochondritic dysplasia, while any abnormalities of the ulna, carpal bones, articular cartilages, ligaments and tendons about the joint, are apparently all of a compensatory nature and secondary to the deformity of the radius.

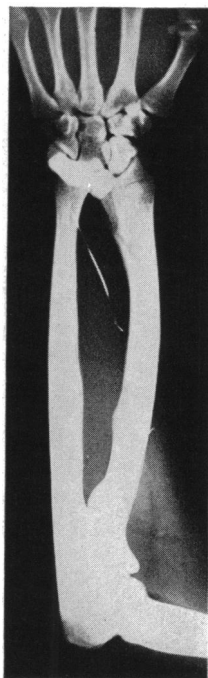


FIG. 4.—Roentgenogram of the entire forearm showing an increase in the normal lateral curvature of the radius, the rarefied area on the internal margin of the lower end of the radius, and the exostosis on its ulnar border.

The Radius.—There is a variable widening of interosseous space, due to an exaggeration of the usual, normal lateral curvature of the diaphysis. The most important disturbance is the palmar bowing of the distal end of the radius, usually in the lower third, its greatest degree being situated at the region of the epiphysis or metaphysis, sometimes as if the epiphysis itself had rotated (Fig. 6).

Kirmisson,¹²² Stetten,^{220, 221} Peckham and Hammond,¹⁶⁶ Gaudier,⁹⁶ and Burrows³⁴ have each reported a case where the usual anterior bowing is



FIG. 5.—Roentgenogram of the skull showing a marked increase in digital impressions, calcification of the pineal body, and a normal sella turcica.

reversed. These constitute the only five authentic cases of posterior bowing or "reverse" type of the deformity (Fig. 7).

The epiphysis has been described as irregular, scalloped and under- or overdeveloped. The epiphyseal line sometimes is found to be broadened, hazy, or entirely absent. If the roentgenograms are examined carefully, it can frequently be appreciated that the epiphyseal line is present only in its lateral half, and its absence in the inner, or ulnar half, is indicative of premature, partial fusion of the shaft and epiphysis. This finding will be noted in the roentgenograms illustrating the present case report.

Another interesting fact, brought out by Rocher¹⁹⁵ and stressed recently by other French authors,^{39, 194, 196, 197, 198, 202} is a hemiatrophy of the internal

MADELUNG'S DEFORMITY

half of the radial epiphysis. This is indicated on the roentgenogram by a small, rarefied area on the internal, or ulnar side of the radial shaft, immediately above the missing half of the epiphyseal line. This finding was also present in the case herewith reported, and was especially marked on the left side

DIAGRAMMATIC SKETCHES ILLUSTRATING THE ANATOMIC RELATIONS OBTAINING IN MADELUNG'S DEFORMITY IN BOTH THE APPARENT ANTERIOR AND POSTERIOR ("REVERSE") DISLOCATIONS

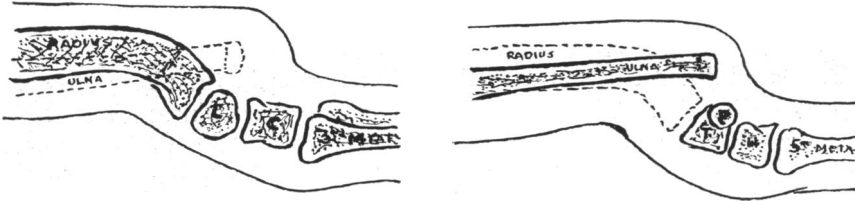


FIG. 6.—Showing the deformity at the back of the wrist, the bowing of the radius and the apparent anterior dislocation. (A) Section through the radius. (B) Section through the ulna.



FIG. 7.—Showing the apparent posterior dislocation of a "reverse" Madelung's deformity. (A) Section through the radius. (B) Section through the ulna.

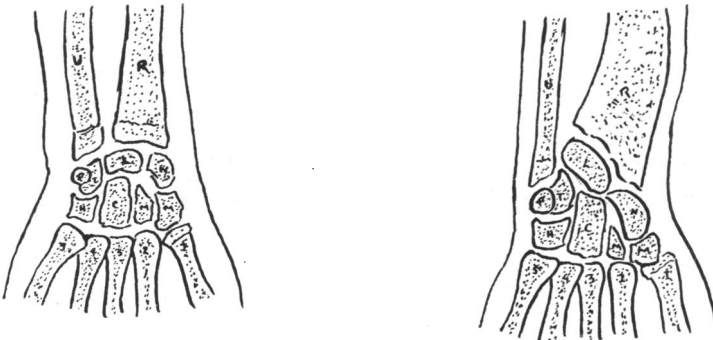


FIG. 8.—(A) Showing the normal arched arrangement of the carpal bones. (B) Showing the "pyramidalization" of the carpal bones in Madelung's deformity, with the os lunatum at the apex.

A third interesting fact, which Stetten²²¹ describes "as a remarkably frequent finding as a coexisting lesion," is the discovery of an exostosis near the distal epiphyseal line, usually on the ulnar side. These three factors are emphasized, and their significance will be appreciated in the consideration of the pathogenesis.

In addition to any apparent shortening of the total length of the radius due to an anterior or lateral curvature, the radius often suffers an actual

shortening in length, and the patient presents obviously foreshortened fore-arms.

The Ulna.—Although slight bowing and shortening of the ulna has also been occasionally described, this is never more marked than the radius, rarely even as much. More usually the ulna grows forward, unaffected by the pathologic radius, thereby leading to a luxation or subluxation of the inferior radio-ulnar articulation. Most descriptions state: "The ulna is dislocated backward from the radius." Rocher, however, has pointed out that, strictly speaking, it is the radius, and not the ulna, which is dislocated. A hyperostosis of the ulnar head is a common finding.

The bowing and shortening of the radius results in the ulna overriding the carpus dorsally. This gives rise to the most prominent sign of the deformity—swelling at the back of the wrist due to the prominence, or projection, of the ulnar head or styloid. Since the ulna is now at a higher level than the hand and carpus, it gives one the impression of an anterior dislocation. In the "reverse" type of the deformity, the ulna projects below the palmar surface of the wrist and results in the appearance of an apparent posterior dislocation of the hand and carpus. The end of the ulna may be forced back into position in cases of mild luxation, but the dislocation returns on release of pressure. The radial deformity cannot be reduced by manipulation, since the deformity is an integral part of the bone.

The Radiocarpal Articulation.—Considering the fact that the radius is deformed in such proximity to the wrist joint, it is inevitable that, in direct proportion to the degree of deformity, the wrist joint will be modified anatomically and functionally. Since the lower end of the radius, which goes to make up the proximal half of the joint, has been bent inward (due to lateral bowing) and downward (or upward in the "reverse" type), the articular surface of the lower end of the radius comes to face downward and somewhat ulnarward, instead of directly forward. Siegrist²¹² describes this as "a deviation of the joint surface on two axes," and his article gives a comprehensive discussion of the mechanics of the modified joint.

Since the inferior radial articulation faces downward, instead of directly forward, an anterior displacement of the hand and wrist takes place. There is no true luxation of the joint whatsoever, since the lunate and navicular bones retain their normal relationships to the articular surface of the radius.

Mobility at the joint is modified by the disturbance of mechanical factors. Thus, the anterior bowing of the radius leaves the joint with an apparently hypertrophied superior lip, thereby limiting extension somewhat. The seeming compensatory atrophy of the inferior lip often augments the range of flexion. In the "reverse" type of bowing, the converse is present, and flexion is found to be limited. Depending on the amount of lateral bowing, adduction is variably restricted. The position of the ulna largely decides what range of abduction may take place. Usually the projecting end of the ulna acts as a splint along the lateral border of the carpus, greatly restricting abduction. Occasionally the projection may so disorganize the lateral side of the joint

that the carpal bones are forced into permanent adduction, and render abduction impossible.

Although the pivot of pronation and supination is at the proximal radio-ulnar joint, both of these motions, particularly that of supination, are variably limited because of: (1) The luxation at the inferior radio-ulnar joint. (2) The bowing of the radius. (3) The disparity in size between the radius and ulna.

It is obvious, therefore, that restrictions, limitations and exaggeration of motion about the wrist are directly dependent upon bony impingements. A laxity of the joint membranes and ligaments, which has been a constant finding on dissection, is a negligible factor. Outside of the fact that the flexor tendons are rendered more prominent by being drawn taut over the inferior margin of the articular surface, they do not enter, essentially, into the pathology of this deformity.

The Hand and Carpal Bones.—The deviation of the articular surface inward leads to a modification of the usual arched arrangement of the carpal bones, which become wedged in between the deformed radius and the protruding ulna, assuming a triangular appearance, with the os lunatum at the apex (Fig 8). Benneke¹³ described this "pyramidalization" of the carpal bones as compensatory to the malarrangement of the component parts of the wrist joint. Slight irregularities of the individual carpal bones have been described.

When the course of the deformity has reached its culmination, the hand and carpal bones come to lie at a lower level than that of the ulna, the hand and forearm assuming a curious and characteristic "bayonet-shaped" deformity (Fig. 1 [A]). This has been persistently described as a "silver-fork" ("*gabelhand*," "*manus furca*") deformity, but it is obviously a misnomer, as can be seen by viewing the wrist from the side. The exception would be those rare cases of the "reverse" type of the deformity, which is really a "silver-fork" deformity. It was probably Stetten's^{220, 221} report describing a case of this type that prompted subsequent authors to misapply that name to the usual deformity.

Of the 171 cases herewith tabulated, it will be noted that the deformities were bilateral in 127 cases, of which 35 were more marked on the right and 21 more marked on the left. Two reports did not state whether a bilateral or unilateral condition existed. Forty-two unilateral cases are reported, of which 18 occurred on the right and 22 on the left side, while in two reports, the side affected was not specified. When both sides are involved, one side usually becomes deformed before the other.

PREDISPOSING FACTORS.—*Sex Incidence.*—The influence of sex is indisputable—females predominating. The ratio of female cases to male is variably put at 2:1 by Madelung,¹³⁵ 31:8 by Abadie,¹ 47:9 by Homuth,¹⁰⁹ 7:1 by Stetten,²²¹ and 4:1 by Salisachs.²⁰³ Analysis of the 171 cases considered in Table I shows a ratio of 137:33 (one not specified), or an approximate ratio of 4:1.

Age Distribution.—This condition is, essentially, an affection of adolescence,

occurring in the secondary growth period, and has its inception, with but few exceptions, between the ages of ten and 14.

Heredity.—Definite instances of a hereditary influence are to be noted in nearly one-third of the reported cases. Guépin¹⁰⁴ reported a case of a girl whose mother presented an even more marked deformity; the father also had large wrists; the sisters and brothers of the mother showed a similar lesion; all nine sisters and brothers of the patient and the children of a sister had had prominent ulnae from childhood. In Jagot's case,¹¹⁴ the father, uncle, and grandfather had thickened wrists, but did not have any functional disturbance. Other instances of the deformity in three generations are to be found in the reports of Roget²⁰⁰—mother and grandfather; Volkmann²³⁴—mother and grandmother; Siegrist²¹²—sisters, mother and grandmother; and Reich.¹⁸⁸ Cases occurring in siblings have been described by Ardouin⁷—brothers; Solberg²¹⁴—brothers, whose parents were cousins; Sauer²⁰⁴—brother and sister; Pedrazzi¹⁶⁷—mother and sister; Vidal²³²—mother and sister; and Wéry²³⁶—sister. Not infrequently the deformity is present in mother and daughter, as cited in the reports of Dekeyser,⁵⁹ Gangolphe,⁹² Malfuson,¹³⁷ Levyn,¹³² and in Stetten's case,²²¹ where there was a history of deformed wrists in the mother. Other instances of a hereditary nature are found in the reports of Estor,⁷⁷ Brandes,²⁶ Salisachs,²⁰³ Gaugele,⁹⁸ Magnus,¹³⁶ and Massabuau.¹⁴³ Nove-Josserand, in the discussion of Gangolphe's⁹² paper, suggests that a latent heredity, becoming active when the hands are first actively used, may be the etiologic factor of the deformity.

Occupation.—This factor was once stressed by the early French writers, but it is illogical to suppose that any condition occurring usually in young girls who are either too young to work or whose work is of a comparatively light nature can claim occupation as an etiologic factor.

Environment.—The high percentage of cases reported from the poorer classes can be easily explained by the fact that it is this class of patients that supply the clinical material upon which most of our medical literature is based. It was the opinion of the early writers that living conditions provided an etiologic factor to the development of this condition comparable, possibly, to the occurrence of rickets, tuberculosis, *etc.*

PATHOGENESIS.—The multiplicity of nomenclature designating this condition reflects the variable pathologic processes propounded, and it has been remarked that there are nearly as many etiologic theories as there are authors. As examples, the following are instructive: "Manus valga" (Madelung, Siegrist and Sauer); "carpus curvus" (Delbet); "radius curvus" (Destot, Gangolphe); "congenital dislocation of the wrist" (Pooley, Estor); "late rickets of the wrist" (Duplay, Salisachs); "progressive subluxation of the wrist" (Kirmisson); "progressive idiopathic curvature of the radius" (Stetten); "adolescent club-hand" (Mauclaire); "carpo-cyfose" (Robinson et Jacoulet); "cubitolisthesis" (Palazzi); "manus furca" or "gabelhand" (Springer); "radius brevior" (Masmonteil); and "dyschondroplasia of the inferior radial epiphysis" (Rocher).

ETIOLOGIC THEORIES.—The following theories have been advanced explaining the etiology of Madelung's deformity, some of which are no longer tenable, but are included for the sake of historic completeness:

(1) *Trauma*.—This factor was advanced by the old French school (Bégin,¹¹ Dupuytren⁷³). Along with the predisposing factor of occupation, trauma has been dropped from serious consideration for much the same reason—its preponderant occurrence in young girls, who are certainly less exposed to trauma than the general population.

(2) *Muscular*.—Madelung¹³⁵ himself, gave credence to this theory when he stated: "The main factor in its causation is the more powerful action of the flexors of the forearm, due to overexertion. Continued hyperflexion stretches the extensor tendons and the posterior ligaments over the dorsum of the radial epiphysis, exerting a forward force and producing a volar bowing." Busch,³⁵ who championed this theory, attempted to correct the deformity by tenotomy of the flexor tendons, but the procedure proved to be ineffectual. This theory could hardly explain those cases of posterior bowing, nor does it take into account the anatomic position of these muscles and the insertions of their tendons, which would lead one to expect deformity to take place in the fingers and hand, rather than at the wrist.

(3) *Nervous*.—This theory, advanced in a hypothetic manner by Félix,⁸¹ is altogether untenable, and is merely mentioned in passing.

(4) *Osseous Dystrophies*.—Landivar¹²⁵ compares the deformity to the group of conditions such as Paget's or von Recklinghausen's disease, *etc.*, but these conditions are each of their own clinical entity, and occasionally, if they should present a "symptomatic" form of Madelung's deformity, as in Bjorkroth's²³ or Rocher's¹⁹³ case, they may be easily differentiated roentgenologically.

(5) *Inflammatory*.—Considering the fact that osteomyelitis, as well as Madelung's deformity, also frequently occurs during the secondary growth period, and that Rosenow has succeeded in demonstrating organisms specific for various parts of the body, it is surprising that this theory has had such fleeting and ineffectual backing. However, this is due to a lack of any positive evidence in its favor.

(6) *Endocrine*.—It is inevitable that the preponderance of female cases would suggest an endocrine basis for the condition. Earl,⁷⁴ Cserey-Pechany,⁵¹ and Beder¹⁰ have reported cases of the deformity which showed mild or severe ovarian hypofunction. Cserey-Pechany gave his two patients ovarian and glandular hormone therapy for a period of seven months. He not only claimed to have checked the course of the disease, but attempted to demonstrate roentgenologically an actual regression of the deformity. However, the course of the disease may cease at any time, even without medication, just as spontaneously and as insidiously as it began. As for the roentgenographic evidence, one must realize that, unless serial exposures are made at exactly the same angle, marked differences in the appearance of the curvature may result.

(7) *Rickets*.—This theory has been regarded as the most frequently pro-

pounded and ardently defended of all. A canvass of the literature reveals a comfortable majority as proponents of the etiologic factor of tardy, or late, rickets. Salisachs²⁰³ is a contemporary exponent of this theory, and a large part of his article is devoted to an attempt to prove its applicability. In rebuttal, we would like to point out that rickets is a constitutional disease, and shows other manifestations besides bony pathology, which are never seen in Madelung's deformity, nor have there been more than one or two cases in all those reported of the condition where other bony manifestations, such as craniotabes, Harrison's groove, rachitic-rosary, *etc.*, have been demonstrated. The occasional coexistence of scoliosis can be explained on the ground of posture, nor is it unusual to find scoliosis coexisting with practically any study made of dispensary patients. The actual existence of rachitis tarda as a clinical entity has been denied by several authors (Holt¹⁰⁸), but even if one were to presume its existence, it would be difficult to explain how it would localize itself to one or both radii, to the exclusion of the rest of the skeletal system, since even those authorities who do believe in the existence of late rickets (Clutton,⁴⁵ Roose²⁰¹) insist that general epiphyseal lesions are essential for a diagnosis.

(8) *Dyschondroplasia of the Distal Radial Epiphysis*.—Even Madelung, in his original presentation, presupposed "a primary weakness of the bone" in the etiology of the deformity, while Redard¹⁸⁶ expounded the idea that the disease was due to a disturbance of growth of the epiphyseal cartilage. Delbet⁶⁰ also concluded that it was due to an irregular development of the epiphyseal cartilage, related to cartilagenous exostosis, analogous to genu varum, but, like Redard, he imputed it to late rickets. Stetten²²¹ states that: "Closer to the correct solution comes the suggestion that the deformity is a disease of the epiphyseal cartilage," and rejects entirely the factor of late rickets.

The mechanism of dyschondroplasia is suggested by the rarity of cases; the remarkable uniformity of the age at the onset; the usual bilateral occurrence; the absence of the usual stigmata of rickets or a history of local trauma; its onset during the secondary growth period; and the frequent association of the deformity with other anomalies. Kun¹²⁴ and Ingber¹¹² report the coexistence of an asymptomatic sacralization of the fifth lumbar metamere; Kajon,¹¹⁹ an homolateral cervical rib; Beder,¹⁰ Brown,³¹ Stokes,²²³ Mathieu,¹⁴⁵ von Bergmann,¹⁷ and Chierici,⁴¹ bowing of the tibiae; Rocher,¹⁹⁷ absence of the caput humerus; Kun¹²⁴ and Vianna,²³¹ spina bifida occulta; von Bergmann¹⁷ and Melchior,¹⁵¹ brachymetacarpals; Solberg,²¹⁴ Franke,⁸⁷ and Fazio,⁸⁰ stunted growth or dwarfism; Gadrat,⁹⁰ Curtillet⁵² and Dimitriu,⁶⁹ multiple exostosis. Possibly if all the cases reported were to have had the entire skeleton examined roentgenologically, numerous other osteochondritic anomalies would have been discovered.

Bessel-Hagen¹⁹ has attempted to demonstrate an arrest in the development of any bone which gives rise to exostosis formation. Stetten²²¹ remarks on the frequency of finding an exostosis near the distal epiphyseal line as a coexisting lesion in Madelung's deformity. The case herewith reported

presents this lesion, which may be noted on the ulnar side of the radius, at the level of the missing epiphyseal line (Fig. 3). According to the observations of Bessel-Hagen, this would lead to an arrest of development on that side, which is apparently what happens. The lateral side of the radius continues to grow at the epiphysis, sweeping the outer margin of the radius along an arc, thereby giving rise to the lateral bowing of the radius. This lateral curvature was stressed particularly by Duplay,⁷² who ascribed it to rickets.

If, as we are inclined to believe, the formation of the exostosis is secondary to, or part of, a premature fusion of part of the epiphysis with the diaphysis, there will result a local cessation of growth. Growing ends of bone are known to receive their blood supply from four sources: (1) The large nutrient artery which supplies the diaphysis; (2) a comparatively small epiphyseal artery; (3) the periosteal vessels, which supply the cortex; and (4) the juxta-epiphyseal vessels, as described by Lexer, which supply the growing metaphysis.

Thus, with premature fusion of part of the epiphysis, this last source of nutrition is cut off, and its loss is indicated by a comparatively rarefied area of bone. This rarefied area, to be found on the ulnar half of the radius, just above the epiphyseal line, is well shown in Figure 3, and has been repeatedly stressed by Rocher^{194, 195, 196, 197, 198} and by Canton.³⁹

The hypothesis of local and partial fusion of only a section of the epiphysis can be deduced from the frequent finding that the epiphyseal line is indistinct, or even partly missing, as is shown in Figure 2. If we apply the same train of thought to early fusion of the volar half of the inferior radial epiphysis, we can see that the anterior bowing of the radius may be the result of local "achondroplasia," and that the mechanism of anterior bowing is dependent upon cessation of growth in the volar half of the epiphysis. This is far more logical than the usual hypothesis, promulgated by Gangolphe,⁹² that the pressure of flexor action leads to an atrophy of the anterior half of the epiphyseal cartilage, with a compensatory hypertrophy of the posterior half.

Pels-Leusden¹⁶⁸ also presented the hypothesis that a disease of the intermediary cartilage caused premature ossification of the ulnar and volar side, with a change in the direction of longitudinal growth. Gickler¹⁰² proposes to explain this premature partial fusion on the ground of a hemorrhage into the metaphysis as a result of disease, weight-bearing (as in crawling about in infancy), slight trauma, or even rickets. Hemorrhage would tend to cut off the local blood supply and lead to early fusion. Redard¹⁸⁶ had previously observed that continuous irritation, such as might be received from performing some particular kind of work (washing, wringing, *etc.*) produced a functional hyperactivity of certain portions of the cartilage.

Fick and Pahl⁸⁴ point out that the dyschondroplasia itself is the basic factor, and any curvature produced is merely accidental, depending upon the portion of the epiphysis which undergoes dyschondroplasia. Cases have been reported by Gickler,¹⁰² and Dee⁵⁷ where no bowing of the radius existed, but where

dyschondroplasia was present. Any early fusion due to dyschondroplasia will give rise to an actual shortening in the length of the radius.

We mention, in passing, that the mechanism of bowing in the rarer "reverse" type of the deformity is the premature fusion of the dorsal half of the radial epiphysis leading to posterior bowing. Stetten²²¹ considers the site of bending of the radius dependent upon the age at which the disease begins, the nearer the lower end of the shaft, the later the affection. Where the entire radius is curved, the process must have begun during intra-uterine life, although a visible deformity may not have been noted until the deformity reached its height. The degree of curvature would depend upon the activity of the pathologic process.

DIFFERENTIAL DIAGNOSIS.—From the foregoing description, it would seem to be quite easy to diagnose this condition, but the large number of similar and secondary deformities which have been improperly introduced into the various bibliographies belies that ease. It is quite possible that fracture, dislocation, arthritis deformans, osseous dystrophies, tumor formation, *etc.*, might produce the bayonet-shaped deformity itself, but a careful history should elicit the spontaneous, idiopathic onset of the disease during the secondary growth period, its progressive nature giving an early clue to the diagnosis. A complete physical examination will reveal an absence of rickets and other general, or local, disturbances. A roentgenologic examination of the lesion would seem necessary to rule out a "symptomatic" form, and would definitely confirm the diagnosis beyond a doubt.

Those authors who have reviewed the literature extensively are almost unanimous in expressing a plea to separate the genuine Madelung's deformity from a "pseudo,"⁴¹ "spurious,"¹⁵³ "symptomatic,"²³ "simulating,"⁷⁰ "atypical"²²⁸ or "similar conditions,"³⁴ and other unrelated types of deformity of the wrist which have masqueraded into the literature of the true variety. Several authors, in deploring this hegira from specificity, have attempted to correct it by adding still more to an already overburdened nomenclature. Zeitlin²³⁹ suggests "Madelung's disease" (*morbus Madelung*), but Madelung has already given his name to a disease characterized by a diffuse symmetrical limpomatosis, or deposit of fatty tissue, on the upper part of the back, shoulders and neck. Burrows³⁴ suggests "Madelung's syndrome," but a deformity is not, strictly speaking, a "syndrome," and it has all the faults of eponymous nomenclature.

In condemnation of the pernicious custom of applying a person's name to a pathologic condition or operation, often undeservedly, we would suggest that Madelung's name be dropped. Sir Jonathan Hutchinson¹¹⁰ has remarked: "So in pathology we have to contend against the tendency to substitute a name, or a definition, for the perception of an essential nature. As it is easier for us to worship a name, or even a book, rather than to conceive of a nonmaterial power, so we more readily become accustomed to content ourselves with some euphonious name for a disease, rather than to acquire the habit of constantly trying to realize its nature and its relation to possible causes."

The Standard Classified Nomenclature of Disease²¹⁹ has a system of

nomenclature based on both a topographic and an etiologic factor. Following their method of classification, Madelung's deformity would be indexed: 23132-077 (that is: distal radial epiphysis—dyschondroplasia of) and we, therefore, suggest calling the deformity "Dyschondroplasia of the Distal Radial Epiphysis."

Several writers, with whom we are inclined to agree, place this deformity among the better known, but equally cryptogenic, group of conditions which includes Perthe-Calvé-Legg's, Osgood-Schlatter's, Köhler's, and Keinboch's diseases. We suggest that these diseases be classified under the head of dyschondroplasias, and that they be renamed, as, for example, dyschondroplasia of the caput femoris instead of Perthe's disease, or scaphoid dyschondroplasia instead of Köhler's disease, *etc.*

Berg¹⁶ and Ewald,⁷⁹ among others, challenge the right of Madelung's deformity to be considered a clinical entity, and advance the opinion that the deformity is merely the sign of some underlying pathology—such as rickets, lues, osteitis deformans, *etc.*

Classifications of Madelung's deformity have already been advanced by Abadie,¹ Barthés,⁹ Depage,⁶⁴ Gasne⁹⁵ and Stetten.²²¹ It would seem advantageous, considering the present state of the literature, to formulate a classification that will include all the various types of the deformity, including the secondary static types. The following classification is, therefore, presented:

A. Presenting Radial Deformity:

- (1) With anterior bowing of the radius:
 - (a) Radial dyschondroplasia (genuine Madelung's deformity).
 - (b) Secondary static deformity: Traumatic;^{70, 237} luetic;⁷⁶ inflammatory;^{64, 21} tuberculous;³⁸ osteitis;^{233, 193} rickets,⁹¹ *etc.*
- (2) With posterior bowing of the radius:
 - (a) Radial dyschondroplasia ("reverse" Madelung's deformity).
 - (b) Secondary static deformity.¹⁵⁰
- (3) Without bowing:
 - (a) Radial dyschondroplasia.^{57, 102}
 - (b) Secondary static deformity.

B. Presenting Ulnar Deformity:

- (a) Ulnar dyschondroplasia.²³⁸
- (b) Secondary static deformity.¹⁶²

PROGNOSIS AND TREATMENT.—Pain may be present as long as the pathology progresses, but ceases when growth is arrested at the wrist, usually before the age of 25. The patient may then be educated in the better use of the deformed wrist.

Treatment, at least up until the cessation of growth, should be palliative, and consists in resting the part. This may be effected by splints, braces, or a plaster encasement, but these measures will not correct the deformity, nor will they prove effective in halting the progress of the disease. Tenotomy of

the flexor tendons of the forearm is unjustifiable, and the mere removal of the distal end of the ulna is also condemned.

Osteotomy of the radius for the correction of the deformity has proven so effective, in competent hands, that it may be recommended routinely, just as one would in a case of badly bowed legs, malunited fracture, *etc.* In 1885, Duplay⁷¹ tried a transverse linear osteotomy; in 1904, an oblique type was advocated by Poulsen.¹⁷⁸ Although these operations may suffice for mild forms of the deformity, most cases may necessitate a cuneiform osteotomy. The curve in the lower end of the radius is corrected, and a plaster encasement is applied, with the hand put up in extension and abduction. Springer,²¹⁸ advises that the hand be forced, if necessary, into supination (depronation). In order to hold the fragments more securely, Taylor²²⁵ inserted a metal plate.

When the ulna is markedly longer than the radius after the osteotomy, its projecting end must be resected in order to obtain a perfect functional result. However, since an osteotomy is liable to shorten an already stunted radius, Burrows³⁴ has devised an ingenious procedure wherein the resected head of the ulna is shaped and inserted as a bone graft, or peg, between the fragments of a linear osteotomy, thereby tending to conserve, or at times elongate, the length of the radius. The postoperative care is the same as for any osteotomy.

SUMMARY

(1) A typical case of Madelung's deformity is presented; the twenty-first to be reported from this country.

(2) The literature on this subject has been reviewed, and is found to be inaccurate, incomplete and is replete with reports of cases that are not genuine. An attempt has been made to correct these errors and to properly correlate the history of this condition.

(3) A tabulation of 171 authentic cases has been compiled.

(4) We advocate the substitution of the term "Dyschondroplasia of the Distal Radial Epiphysis" in place of "Madelung's deformity," since the latter term is not specific.

(5) A classification of the various types of the deformity has been formulated.

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BIBLIOGRAPHY

WITH

INTRODUCTION OF REMARKS RELEVANT TO EACH ARTICLE

¹ Abadie, J.: De la subluxation progressive du poignet, chez l'adolescent. *Revue d'Orthopédie*, 4, 481-510, 1903, (1 case; review and tabulated bibliography of 41 cases; complete up to 1903.)

² Abadie, J.: Sur le mécanisme des luxations du poignet. *Bull. de la Société Anatomique*, Paris, 74, 274-275, 1904. (This is on the subject of true luxation and not Madelung's.)

³ Adams: *Soc. Pathology of Dublin*, 1838. (Apparently a traumatic injury and not a true Madelung's deformity.) Not obtainable.

- ⁴ Adler, Howard F.: Madelung's Deformity. *California State Journal of Medicine*, **12**, 103-105, March, 1914. (1 case.)
- ⁵ Albertin et Leclerc: Un cas de Radius Curvus. *Revue de Chirurgie*, **31**, 551-552, 1905. (1 case.)
- ⁶ Anzilotti, Giulio: Sopra una deformità del polso tipo Madelung. VI, Congresso della Società Ortopedica Italiana. *Archivio di Ortopedia*, **28**, 537-549, 1911. (Case of traumatic deformity.)
- ⁷ Ardouin, P.: Un cas de luxation congénitale incomplète du poignet. *Revue d'Orthopédie*, **3**, 351-353, 1902. (1 case.)
- ⁸ Barsoum, S.: Madelung Deformity. *Lancet*, **2**, 428, August 24, 1935. (1 case.)
- ⁹ Barthés, Louis Charles: De la luxation progressive du poignet chez l'adolescent et chez l'adult. Thèse de Paris, 495, July 19, 1904. (Describes cases of Malgaigne, Gevaert, Guéry, Lesauvage and Madelung. Of his own two cases, one is probably exuberant callus after fracture of scaphoid, the other an unrelated type of contracture.)
- ¹⁰ Beder, W. L., und Heinismann, J. I.: Zur Genese Madelung'schen Deformität. *Fortschrift a.d.Geb. d. Roentgenstrahlen*, **52**, 595-601, December, 1935. (Two cases—Importance of endocrine (ovarian) dysfunction in the genesis of Madelung's deformity.)
- ¹¹ Bégin: Radiocarpien. *Dictionnaire des sciences médicales*, **13**, 491-498, 1825. (Description on page 493 of an occupational deformity.)
- ¹² Bégin: *Bull. de l'Acad. de Méd. de Paris*, **6**, 803, June 20, 1841. (Discussion of Scoutetten's²¹⁰ paper.)
- ¹³ Benneke, E.: Über einen Fall von sogenannter progressiver Luxation des Handgelenkes. *Verhandlungen der deutschen Gesellschaft für Chirurgie*, **31**, 157-159, 1904. (1 case.)
- ¹⁴ Bennett, William H.: A Case of Spontaneous Displacement Forward of Both Wrists. *Transactions of the Clinical Society of London*, **25**, 265-267, 1892. (Author evidently unaware of Madelung's report. Two cases are suggestive of Madelung's deformity but only Case 2 is acceptable even though description is meager.)
- ¹⁵ Bérard: Description of a Case, in Discussion of Gangolphe's⁹² Paper. *Bulletin de la Société de Chirurgie de Lyon*, **2**, 135, 1899. (Too meager for acceptance.)
- ¹⁶ Berg, Peter: Die Madelung'schen Deformität des Handgelenkes: Carpus valgus. *Archiv für Orthop. Mechan. und Unfall-Chirurgie*, **12**, 325-338, 1913. (Case 1 accepted; Case 2 rachitic; Case 3 accepted.)
- ¹⁷ von Bergmann: Subluxation beider Hände. *Freie Vereinigung der Chirurgen Berlins*, October 8, 1888; *Deutsche medizinische Wochenschrift*, **14**, 861, 1888. (1 case.)
- ¹⁸ Bertolotti, Orazio: La malattia di Madelung o Cubitolitesi posteriore. *La Medicina Pratica*, **13**, 95-99, March 1, 1928. (1 case.)
- ¹⁹ Bessel-Hagen, Fritz: Über Knochen- und Gelenkanomalien, insbesondere bei partiellem Riesewuchs und bei multiplen cartilaginären Exostosen (Über angeborene und pathologische Luxationen des Radiusköpfschens). *Archiv für Klinische Chirurgie*, **41**, 420-435, 1891. (Presents no true cases of Madelung's, but points out relationship of exostosis formation.)
- ²⁰ Bideau: De la Maladie de Madelung. Thèse de Bordeaux, 1909. (Not obtainable.)
- ²¹ Binet, Trenel, et Worms: Les incurvations des os de l'avant-bras consécutives à l'osteomyélite de leur extrémité inférieure. *Archives Méd. des Enfants*, Paris, **13**, 353-362, 1910. (Deformity secondary to osteomyelitis.)
- ²² Binet, A., et Mutel, M.: Le Radius Curvus. *Revue de Chirurgie*, Paris, **48**, 567-584, 1913. (A case of generalized rickets.)
- ²³ Bjorkroth, Torsten: An Extraordinary Case of Deformity of the Wrist (Symptomatic Form of Madelung's Deformity). *Acta Orthopaedica Scandinavia*, **2**, 242-252, 1932. (Not a true deformity.)
- ²⁴ Bode, Otto: Demonstration eines Falles von Spontanluxation der Hand. *Freie Vereinigung der Chirurgen Berlins*, June 8, 1891; *Berliner Klinische Wochenschrift*, **28**, 900, 1891. (1 case.)

- ²⁶ Bode, O.: Ein Beitrag zur Aetiologie und Casuistik der Spontanluxation der Hand. *Berliner Klinische Wochenschrift*, **28**, 1128-1130, 1891. (Discussion.)
- ²⁹ Brandes, Max: Zur Madelung'schen Deformität des Handgelenkes. *Zeitschrift für Orthopädische Chirurgie*, **28**, 392-414, 1911. (3 cases.)
- ²⁷ Brindeau, A.: Luxation congénitale du Radius. *Bull. de la Soc. d'Obstet. de Paris*, **11**, 140-141, 1908. (Deformity of elbow.)
- ²⁸ Brinsmade, William B.: Madelung's Deformity of the Hands. *N. Y. Surg. Soc., ANNALS OF SURGERY*, **47**, 794, 1908. (1 case.)
- ²⁹ Broca, August: Radius Curvus. *La Tribune Médicale, Paris*, **3**, 759-760, 1905. (Discussion, no report.)
- ³⁰ Broca, A.: Discussion sur la tuberculose inflammatoire (discussion on the report of Poncet et Leriche).¹⁷⁴ *Bull. et Mém. de la Soc. de Chirurgie de Paris*, **34**, 1004-1005, July 29, 1908.
- ³¹ Brown, George M.: Report of a Case of Madelung's Deformity. *Medical Clinics of North America*, **6**, 1313-1318, March, 1923. (1 case.)
- ³² Bsteh, O.: Radiusfraktur bei Madelung'schen Deformität. *Zentralblatt für Chirurgie*, **58**, 1955-1957, 1931. (Traumatic case.)
- ³³ Burnier, R., et Neveux, A.: Luxation bilaterale et symétrique de l'extrémité inférieure du cubitus en arrière avec radius curvus (Maladie de Dupuytren-Madelung et ses Variétés). *Archives Générales de Chirurgie*, **3**, 805-817, 1909. (1 case; discusses different degrees of the deformity.)
- ³⁴ Burrows, H. Jackson: Operation for the Correction of Madelung's Deformity and Similar Conditions. *Proceedings of the Royal Society of Medicine*, **30**, 567-572, March, 1937. (Cases 1 and 2 are Madelung's; Case 3 is inflammatory.)
- ³⁵ Busch, Wilhelm: *Lehrbuch der Chirurgie*, Berlin, **2**, Part 5, 111, 1864.
- ³⁶ Cabeça, Custodio: Sub-luxação espontanea do punho; Carpus-curvedus. *Revista portuguesa de medicina e cirurgia praticas*, **6**, 51-58, 1899. (1 case.)
- ³⁷ Callandra, E.: Sulla Radio-dystrofia del Madelung. *Corso di lesioni di ortopedia Anno Accademico 1927-1928*. (Not obtainable.)
- ³⁸ Cantas, M.: Contribution à l'étude de la pathogénie de la déformation de Madelung ou Radius curvus; Sur un cas de maladie de Madelung ou Radius curvus d'origine tuberculeuse. *Lyon Chirurgie*, **10**, 434-469, 1913. (Tuberculous deformity.)
- ³⁹ Canton, J.: Un cas de dyschondroplasia radio-cubitale inférieure avec hémiatrophie épiphysaire radiale. *Revue d'Orthopédie*, **22**, 58-62, 1935. (1 case.)
- ⁴⁰ Catterina, A.: Contributo allo studio della malattia di Madelung. *La Chirurgia degli Organi di Movimento*, **10**, 517-532, April, 1926. (1 case.)
- ⁴¹ Chierici, Romola: Madelung e Pseudo-Madelung. *Quaderni Radiologici*, **7**, 3-24, 1936. (2 cases true; 2 pseudo.)
- ⁴² Ciacca, S.: Luxation isolée palmaire du cubitus dans l'articulation radio-cubitale inférieure. *Archiv. italiano di Chirurgia*, **24**, 125, 1924. (Dislocation; not Madelung's.)
- ⁴³ Claiborne, E. M., and Kuntz, T. G.: Madelung Deformity with Report of a Case. *Radiology*, **27**, 594-599, November, 1936. (1 case.)
- ⁴⁴ Clarke, J. Jackson: Acquired Spontaneous Subluxation of the Wrist. *Orthopedic Surgery*, London, 216-217, 1899. (This frequently quoted text is brief and inaccurate.)
- ⁴⁵ Clutton, N. H.: On Adolescent or Late Rickets. *Lancet*, **2**, 1268-1271, 1906.
- ⁴⁶ Cnopf: Über Madelung's spontane Subluxation des Handgelenks nach vorn. *Festschrift für Hofrat Göschel, Tübingen*, 1902; abstracted in *Zentralbl. f. Chir.*, **30**, 574-575, 1903. (1 case.)
- ⁴⁷ Codet-Boisse, P.: Déformation symétrique des deux poignets du type Dupuytren-Madelung. *Revue d'Orthopédie*, **2**, 35-45, 1911. (1 case.)
- ⁴⁸ Colle, G.: Luxations divergentes des têtes du radius et du cubitus. *Archivio italiano di Chirurgia*, **15**, 685-697, June 6, 1926; abstracted in *Journal de Chirurgie*, **28**, 748, 1926. (Traumatic deformity.)

- ⁴⁹ Cruvelhier: *Traité d'Anatomie Pathologique*, Paris, 1849, 9. This case, described by Smith,²³ is too indefinite for acceptance.)
- ⁵⁰ Crysospathes, d'Antrenes: Zwei Fälle von gegengleicher Madelung's Deformität zugleich ein Beitrag zur Ätiologie derselben. *Arch. für Orthop. Mechanotherapie und Unfall. Chirurgie*, 11, 328-338, 1912. (Cases of traumatic deformity.)
- ⁵¹ Cserey-Pechany, Albin: Beitrag zur Ätiologie und Therapie der Madelung'schen Krankheit. *Zentralblatt für Chirurgie*, 57, 774-777, March, 1930. Case 1—Generalized rickets; Case 2—Madelung's, possible ovarian origin and ovarian hormone treatment.)
- ⁵² Curtillet, J.: Quatre cas d'exostoses ostéogéniques multiples héréditaires et familiales. *Revue d'Orthopédie*, 3, 193-206, 1912. (Four cases having multiple exostoses. Case 2 resembles "radius curvus" but is not specific enough for acceptance.)
- ⁵³ Dalbera, Maurice: La Loi d'Ollier. Son application en pathologie notamment dans la maladie de Madelung et l'Hémimélie partielle. Thèse de Paris, 160, 1927. (Relation of Ollier's law to Madelung's deformity.)
- ⁵⁴ David, Max: Die Spontane subluxation des Handgelenkes. *Grundriss der Orthopädischen Chirurgie*, Berlin, 121, 1900; 140, 1906. (Brief description but no new case report.)
- ⁵⁵ Davoineau, et Lehmann, R.: Trois cas de maladie de Madelung. *Société Française d'électrothérapie et de Radiologie*, October 24, 1923. *La Presse Médicale*, 31, 955, 1923. (Three cases are presented but, although suggestive, are too briefly described for acceptance.)
- ⁵⁶ DeBernardi, Renato: Contributo radiologico allo studio della deformità di Madelung. *La Radiologia Medica*, 12, 393-398, 1925. (2 cases.)
- ⁵⁷ Dee: Spontaneous Luxation of Wrists—Madelung's Deformity. *Medical Journal of South Africa*, 16, 158, 1920-1921. (Case of dyschondroplasia of the inferior radial epiphysis, but no bowing of radius.)
- ⁵⁸ Define, Domingos: Sobre un caso de deformidade de Madelung. *Annaes Paulistas de Medicina e Cirurgia*, 15, 237-245, 1924. (1 case.)
- ⁵⁹ Dekeyser, Arthur: Subluxation spontanée du poignet; Subluxation de Madelung. *Journal Médicale de Bruxelles*, 6, 593-597, 1901. (2 cases.)
- ⁶⁰ Delbet, Pierre: Carpus Curvus. *Leçons de clinique chirurgicale faites à l'Hôtel Dieu*, Paris, Aug.-Sept., 1897. Paris, 161-190, 1899. (1 case; excellent discussion.)
- ⁶¹ Delitala: Sulla malattia di Madelung. XIX Congresso della Società Italiana di Orthopedia, October 10, 1928. *La Riforma Medica*, 44, 1498, 1928; *La Clinica Chirurgica*, 31, 1256, 1928. (Description of two cases, too meager for acceptance.)
- ⁶² Denucé et Rabere: Subluxation progressive des poignets, Maladie de Madelung. *Journal de Médecine de Bordeaux*, 38, 58-59, 1908. (1 case.) Thèse de Bordeaux, 1908. (Not obtainable.)
- ⁶³ Depage, A.: Un cas de maladie de Madelung. *Société Clinique des Hôpitaux de Bruxelles*. *Journal Médicale de Bruxelles*, 10, 673, 1905. (Not a true case of Madelung's; see ref. 64.)
- ⁶⁴ Depage, A.: Note clinique à propos de la subluxation du poignet ou maladie de Madelung. *Journal Médicale de Bruxelles*, 11, 401-406, 1906. (Deformity due to inflammation.)
- ⁶⁵ Ders: Die Madelung'schen Deformität der Hand. *Hospitalstindende*, 33, Kopenhagen. (Not obtainable.)
- ⁶⁶ Destot, Etienne: Traumatismes du poignet et Rayons-X. *Masson et Cie*, Chapt. vii, 1923; Luxations radio-carpienne. (Fig. 69 shows a roentgenogram of true Madelung's, but there is no case report. See also Destot's note to Gangolphe's^{62, 63} paper.)
- ⁶⁷ Destot, Etienne: Injuries of the Wrist, a Radiological Study. *Hoeber*, New York, 1926. (English translation of the above text by Atkinson.)

- ⁶⁸ Destot et Gallois: Recherches physiologiques et expérimentales sur les Fractures de l'extrémité inférieure du Radius. *Revue de Chirurgie*, **18**, 886-915, 1898. (This is an excellent thesis on fractures, but makes no mention of Madelung's.)
- ⁶⁹ Dimitriu, V.: Un cas rare de maladie de Madelung. *Journal de Radiol. et d'Electrol.*, **18**, 535-536, October, 1934. (Case is one of multiple exostoses of long bones.)
- ⁷⁰ Dónovan, Ricardo F.: Deformación traumática radiocarpiana (simulando un caso de Madelung). *Boletines y Trabajos de la Sociedad de Chirurgia de Buenos Aires*, **16**, 1405-1409, November 16, 1932. (Traumatic deformity.)
- ⁷¹ Duplay, Simon: De l'ostéotomie lineaire du radius pour remédier aux difformités du poignet, soit spontanées, soit traumatiques. *Archives Générales de Médecine*, **15**, 385-395, April, 1885. (1 case.)
- ⁷² Duplay, Simon: Un cas de rachitisme tardif des poignets. *Gazette des Hôpitaux*, **64**, 1397-1398, 1891. (1 case.)
- ⁷³ Dupuytren: Leçons orales de clinique chirurgicale faites à l'Hôtel Dieu de Paris, **4**, 209-210, 1834. (Describes occupational deformities.)
- ⁷⁴ Earl, George: Madelung's Deformity. *The Journal-Lancet*, **36**, 229-232, 1916. (1 case.)
- ⁷⁵ Elmslie, R. C.: Madelung's Deformity of Left Wrist. *Proceedings of the Royal Society of Medicine*, 1921-1922, **15**, Part iii, Section Surgery, subsection Orthopedics, p. 82. (Only mentions presentation of case. No description warranting acceptance.)
- ⁷⁶ Erlacher, Philip: Gabelhand bei kongenitaler lues. *Beiträge zur Entstehung der Madelung'schen Deformität. Archiv für Klinische Chirurgie*, **125**, 776-789, 1923. (Luetic deformities.)
- ⁷⁷ Estor, E.: De la Subluxation Congénitale du poignet. *Revue de Chirurgie*, **36**, 145-168, 317-348, 1907. (1 case.)
- ⁷⁸ Ewald, Paul: Zur Aetiologie der Madelung'schen Deformität. *Archiv für Klinische Chirurgie*, **84**, 1099-1111, 1907. (Case is traumatic.)
- ⁷⁹ Ewald, Paul: Die Madelung'schen Deformität als Symptom und als Krankheit sui Generis. *Zeitschrift für Orthop. Chirurgie*, **23**, 470-497, 1909. (9 cases of wrist deformity presented; only 1 (Case 7) may be accepted as Madelung's.)
- ⁸⁰ Fazio, Leonardo: Sulla radiodistrofia del Madelung. *Archiv. di Ortop.*, **44**, 551-565, June 30, 1930. (1 case.)
- ⁸¹ Félix, Joseph: Étude sur la subluxation spontanée du poignet en avant. Thèse de Lyon, 246, 1884. (2 cases.)
- ⁸² Felix, W: Beitrag zur Kasuistik der Madelung'schen Deformität. *Zeitschrift für Orthop. Chirurgie*, **49**, 563-568, 1928. (Cases 1 and 2, traumatic; Case 3, rachitic; Case 4, true Madelung's—1 case.)
- ⁸³ Féré, Ch.: Note sur les difformités de développement du cubitus et de la clavicule. *Revue de Chirurgie*, **16**, 398-402, 1896. (1 case.) (Claims to have seen 24 cases in epileptic patients, but these are probably traumatic and are too indefinite for inclusion.)
- ⁸⁴ Fick, R., und Pahil, J.: Über einen Fall von doppelseitiger Madelung'schen Fehlform des Handgelenks mit Berücksichtigung seiner Mechanik. *Archiv. für Klinische Chirurgie*, **163**, 499-518, 1931. (1 case.)
- ⁸⁵ Finzi: The Cause of Madelung's Deformity. *Seventeenth International Congress of Medicine*, London, 1913, **7**, Part 2, Orthopedics, 339-344. (1 case.) *La Presse Médicale*, **21**, 727, 1913. (Same case.)
- ⁸⁶ Foschini, Domenico: Contributo alla patogenesi della deformità di Madelung. *Giornale di Clinica Medica*, **8**, 510-513, August 31, 1927. (1 case.)
- ⁸⁷ Franke: Zur Anatomie der Madelung'schen Deformität der Hand. *Deutsche Zeitschrift für Chirurgie*, **92**, 156-180, 1908. (1 case, with dissection. This is the same case as that by Müller.¹⁸⁵)
- ⁸⁸ Frölich, M.: Radius Curvus ou Maladie de Madelung. *Revue Médicale de l'est*, **1**, 586-587, 1922. (Discussion on Mathieu's^{144, 145} case.)

- ⁸⁸ Frölich, M.: Discussion on Finzi's⁸⁶ paper. Seventeenth International Congress of Medicine, London, 1913, 7, Part 2, Orthopedics, pp. 344. (Case described is too indefinite for inclusion and is probably that of Mathieu and Joseph,^{144, 145} q.v., upon which he operated.) Also see *La Presse Médicale*, 21, 592, 1913. (Case 1, as above; Case 2 arthritis; Case 3, osteomyelitis.)
- ⁸⁹ Gadrat, J., et Marques, Pierre: Exostoses Ostéogéniques multiples et main de Madelung. *Journal de Radol. et d'Electrol.*, 19, 72-78, February, 1935. (Several cases of multiple exostoses of long bones, not typical of Madelung's deformity.)
- ⁹¹ Gaillot, Gaston Henri: Contribution à l'étude de Radius Curvus. Thèse de Lille, 18, 1907. (Case of generalized rickets.)
- ⁹² Gangolphe: Déformation singulière du poignet inexactement dénommée subluxation spontané. *Bulletin de la Société de Chirurgie de Lyon*, 2, 117-123, 126, 135, 1899. (2 cases.)
- ⁹³ Gangolphe: Malformation congénitale du poignet. *Lyon Médicale*, 90, 451, 1899. (Same cases as above.⁹²)
- ⁹⁴ Garrido-Lestache, J.: Un caso de enfermedad de Madelung. *La Pediastría Española*, 14, 138-143, 1925. (1 case.)
- ⁹⁵ Gasne, Ernest: Déformation rachitiques tardives du poignet. Subluxation de Madelung et Radius Curvus. *Revue d'Orthop.*, 7, 153-170, 241-260, 1906. (No case reports.)
- ⁹⁶ Gaudier, H.: Déformation rachitique symétrique des deux poignets par radius curvus. *Revue d'Orthopédie*, 10, 263-266, 1909. (1 case.)
- ⁹⁷ Gaugele, Karl: Madelung'schen Handgelenks Deformität. *Archiv. für Klinische Chirurgie*, 88, 1058-1075, 1909. (Cases 1 and 2, no bowing of radius Case 3, ref. 98.)
- ⁹⁸ Gaugele, Karl: Gibt es eine genuine Madelung'sche Handgelenks Deformität? *Zeitschrift für Orthop. Chirurgie*, 24, 462-479, 1909. (4 cases; 3 are accepted; the fourth was rachitic.)
- ⁹⁹ Gazzotti, L. G.: Contributo al trattamento della deformità di Madelung. *La Chirurgia degli Organi di Movimento*, 16, 263-273, July, 1931. (1 case.)
- ¹⁰⁰ Gery, de Chastenot et Colombier: Deux cas de Radius Curvus. *Bull. et Mém. de la Société d'Anatomie de Paris*, 17, 370-376, 1920. (2 cases, with dissection of Case 1.)
- ¹⁰¹ Gevaert, G.: Un cas de subluxation du poignet de Madelung. *Revue d'Orthopédie*, 2nd series, 3, 335-342, 1902. (1 case.)
- ¹⁰² Gickler, H.: Wachstumsstörung der Radiusepiphyse und Madelung'sche Deformität. *Archiv. für Orthop. und Unfall Chirurgie*, 33, 312-318, 1933. (4 cases of dyschondroplasia of the inferior radial epiphysis, but with no bowing of radius.)
- ¹⁰³ Greig, D. M.: Congenital Dislocation of the Ulna. *Edinburgh Medical Journal*, 31, 373-391, July, 1924. (1 case.)
- ¹⁰⁴ Guépin, A.: Laxité congénitale de l'articulation radio-cubital inférieure et subluxation consecutive de la tête du cubitus en arrière. *Comptes rendus hebdomadaires des séances et mémoires de la Soc. de Biologie*, 44, 627-631, 1892. (2 cases with a history of similar deformity in 14 members of the family.)
- ¹⁰⁵ Guéry, A.: Un cas de luxation progressive du poignet (Subluxation spontanée de Madelung). *Revue d'Orthopédie*, 9 277-282, 1898. (1 case.)
- ¹⁰⁶ Guye: Observation d'un cas de maladie de Dupuytren-Madelung bilaterale. *Revue Médicale de la Suisse Romane*, 39, 191-192, April, 1919. (1 case.)
- ¹⁰⁷ Hoffa, Albert: *Lehrbuch der Orthopädischen Chirurgie*, 1st Edit., 486-488, 1891; 5th Edit., 510-511, 1905. (Text; no case report.)
- ¹⁰⁸ Holt, C. Emmet: *The Diseases of Infancy and Childhood*. 4th Edit., 268, 1908.
- ¹⁰⁹ Homuth, Otto: Die Madelung'sche Deformität in ihrer Beziehung zur Rachitis. *Beiträge zur Klinischen Chirurgie*, 74, 562-584, 1911. (Case of generalized rickets.)
- ¹¹⁰ Hutchinson, Sir Jonathan: Some General Remarks on the Series of Cases and on the Employment of Names. (*Archives of Surgery*, London, 9, 26-27, 1898.)
- ¹¹¹ Ianni, Raffaele: Radius Curvus; Deformità di Madelung-Duplay. *Annali Italiana di Chirurgia*, 3, 40-61, 1924. (1 case.)

- ¹¹² Ingber, E.: Bilateral Madelung Deformity and True Asymptomatic Sacralization of the fifth Lumbar Metamere; Roentgen Study of a Case. *Quaderni Radiologia*, **5**, 251-257, 1934. (1 case; not obtainable.)
- ¹¹³ Jacoulet, F.: Un cas de maladie de Dupuytren-Madelung. *Revue d'Orthopédie*, **1**, 35-42, 1910. (1 case.)
- ¹¹⁴ Jagot, C.: Sur une vice héréditaire de conformation des deux poignets. *Archives Méd. d'Angiers*, **1**, 159-170, 1897. (1 case.)
- ¹¹⁵ Jean, A.: Double luxation congénitale complète du cubitus et incomplète du radius sur les os du carpe. *Bull. de la Soc. Anat. de Paris*, **10**, 398-400, 1875. (1 case, dissected.)
- ¹¹⁶ Jones, S. Fosdick: Bilateral Congenital Dislocation of the Lower End of the Ulna. *American Journal of Orthopedic Surgery*, **9**, 199, November, 1911. (1 case.)
- ¹¹⁷ Jóna, László: A csuklo Madelung-féle deformitásanak egy esete. *Orvosi Hetilap*, **70**, 1321-1324, 1926. (1 case.)
- ¹¹⁸ Joüon, E.: Déformation de l'avant-bras par arrête développement de l'extrémité inférieure du cubitus, de cause inconnue. *Revue d'Orthopédie*, **6**, 81-84, 1905. (Case of ulnar dyschondroplasia with deformity of the radius.)
- ¹¹⁹ Kajon, Cesar: Madelung'sche Deformität konbiniert mit Halsrippen. *Wien. med. Wochenschrift*, **84**, 460-462, April 21, 1934. (1 case with cervical ribs.)
- ¹²⁰ Kieffer, Charles F.: Congenital Dislocation of Both Ulnae at the Wrists. *ANNALS OF SURGERY*, **38**, 119, 1903. (1 case.)
- ¹²¹ Kassowitz, M.: Die Ursache der Gelenkschlaffheit der Rhachitis. *Centralblatt für Chirurgie*, **9**, 385-390, 1882. (This much quoted article presents no cases nor mentions Madelung's deformity.)
- ¹²² Kirmisson, E.: Subluxation progressive du poignet. Les déformités acquises de l'appareil locomoteur pendant l'enfance et l'adolescence. *Masson et Cie, Paris*, 363-375, 1902. (1 case.)
- ¹²³ Kolliker, Th.: Die Dupuytren'sche und Madelung'sche Deformität des Handgelenkes. *Joachimstahl's Handbuch der Orthopädischen Chirurgie*, **2**, 34-37, 1907. (Text; no case report.)
- ¹²⁴ Kun, Etienne: Contribution à l'étude de la Maladie de Madelung. *Thèse de Paris*, 1933, 23. (Case 1, traumatic; Case 2, Madelung; Case 3, generalized rickets.)
- ¹²⁵ Landivar, Adolfo F. y Iparraguirre, and César, A. Leoni: Radius Curvus bilateral de comienzo tardio. *Bol. y Trab. de la Soc. de Cir. de Buenos Aires*, **20**, 1160-1168, November, 1936. (1 case.)
- ¹²⁶ Laurence, Joseph: La Maladie de Dupuytren-Madelung. *Revue Générale de Clinique et de Thérapeutique, et Journal des Practiciens*, **37**, 75, 1923. (Discussion.)
- ¹²⁷ Leclerc: Radius Curvus. *Bulletin de la Société de Chirurgie de Lyon*, **8**, 115-120, 1905. (Same case as Albertin and Leclerc.)*
- ¹²⁸ Lenormant, Ch.: Un nouveau cas de radius curvus. *Revue d'Orthopédie*, **7**, 1-10, 1907. (1 case.)
- ¹²⁹ Leriche, R.: Sur un cas de Maladie de Madelung bilaterale. Par lesion du cartilage de conjugaison radiale. *Revue d'Orthopédie*, **10**, 495-500, 1909. (1 case.)
- ¹³⁰ Lesauvage, de Caen: Mémoire théorique et pratique sur les luxations dites spontanées ou consécutives et en particulier sur celles du femur. *Archives Générales de Médecine*, **9**, 257-284, November, 1835. (Case 1, on page 260, is a pathologic dislocation.)
- ¹³¹ Levy, Richard: Über Madelung'sche Handgelenksdeformität. *Berliner Klinische Wochenschrift*, **45**, 2213-2216, 1908. (Case of rickets.)
- ¹³² Levyn, L.: Madelung's Deformity; A Report of Two Cases, Constituting the Fifth and Sixth American Cases. *Radiology*, **3**, 145-149, August, 1924. (2 cases.)
- ¹³³ Lladó, Antonio Cortés, y Gallardo, Louis Salvador: Estudio de la anatomia y patogenia de un caso de deformidad de Madelung. *Revista Médica de Barcelona*, **4**, 251-274, September, 1925. (1 case.)

- ¹³⁴ MacLennan, Alex: Report of a Case of Madelung's Deformity. *British Medical Journal*, **2**, 759-760, 1909. (1 case.)
- ¹³⁵ Madelung: Die spontane Subluxation der Hand nach vorne. *Verhandlungen der Deutschen Gesellschaft für Klinische Chirurgie*, **23**, 395-412, 1879. (5 cases.)
- ¹³⁶ Magnus, Georg: Über Madelung'sche Deformität. *Medicinische Klinik Berlin*, **8**, 2069-2070, 1912. (1 case.)
- ¹³⁷ Malfuson, Daniel: Déformation du poignet d'origine probablement rachitique. Thèse de Paris, July 28, 1894. (2 cases.)
- ¹³⁸ Malgaigne, J. F.: *Traité des fractures et des Luxations*. Paris, **2**, 711-712, 1855. (1 case.)
- ¹³⁹ Marsan, Felix: Sur un nouveau cas de maladie de Madelung. *Archives Générales de Chirurgie*, **2**, 472-482, November, 1908. (1 case.)
- ¹⁴⁰ Marsan, Felix: La Maladie de Madelung (Radius Curvus). *Gazette des Hôpitaux*, **81**, 1671-1679, 1909. (No new reports, but an excellent discussion and bibliography up to 1909.)
- ¹⁴¹ Masmonteil, Fernand: À propos de la pathogénie de la maladie de Madelung (Radius Brevior). *Gazette des Hôpitaux*, **93**, 101-103, 1920. (Traumatic deformity.)
- ¹⁴² Masmonteil, Fernand: Toujours à propos de la pathogénie de la maladie de Madelung. *Lyon Chirurgical*, **18**, 351-355, 1921. (1 case.)
- ¹⁴³ Massabuau, Soulas et Nichet: La Maladie de Madelung. *Archives de la Soc. Méd. et Biol. de Montpellier*, **15**, 191-195, May, 1934. (1 case.)
- ¹⁴⁴ Mathieu, Ch., et Joseph, V.: Radius Curvus Bilateral. *Société Méd. de Nancy*, May 24, 1922; *Revue Médicale de l'est*, **1**, 586, 1922. (Same case ref. 145.)
- ¹⁴⁵ Mathieu, Ch., et Joseph, V.: À propos d'un cas de Maladie de Dupuytren-Madelung bilaterale. *Revue Médicale de l'est*, **1**, 691-701, 1922. (2 cases.)
- ¹⁴⁶ Mauclaire: Discussion on Finzi's⁸⁵ paper, Seventeenth International Congress of Medicine, London, 1913, **7**, Part 2, Orthopedics, p. 344.
- ¹⁴⁷ Mauclaire: Trois observations de subluxation progressive du poignet. *Comptes rendus de la Soc. de Chir. de Paris*, February 9, 1916; *Bulletins et Mémoires de la Société de Chirurgie de Paris*, **42**, 344, 1916. (3 cases.)
- ¹⁴⁸ Mauclaire: À propos du radius curvus. *Société de Chirurgie de Paris*, February 11, 1925; *Presse Médicale*, **33**, 223, 1925. (Brief mention of the 3 cases reported above.¹⁴⁷)
- ¹⁴⁹ Mauclaire et Labadie-Lagrave: Un cas de Maladie de Madelung. *Bull. et Mém. de la Soc. de Chirurgie de Paris*, **35**, 695-596, 1906. (1 case.)
- ¹⁵⁰ Mazzini, Osvaldo, F.: Enfermedad de Madelung. *La Semina Médica de Buenos Aires*, **32**, 626-639, 1925. (1 case.)
- ¹⁵¹ Melchior, Edouard: Über die Kombination von symmetrischen Madelung'scher Handgelenksdeformität mit doppelseitiger metakarpaler Brachydaktylie. *Zeitschrift für Orthopädische Chirurgie*, **30**, 532-537, 1912. (1 case.)
- ¹⁵² Melchior, Edouard: Die Madelung'sche Deformität des Handgelenks. *Ergebnisse der Chirurgie und Orthopädie*, **6**, 649-680, 1913. (Discussion.)
- ¹⁵³ Merlini, A.: La deformità di Madelung. *La Chirurgia degli Organi di Movimento*, **9**, 245-268, March, 1925. (Case 1—Madelung; Case 2—traumatic.)
- ¹⁵⁴ Moore, B. H.: Radius Curvus; Madelung's Wrist. *Journal of Bone and Joint Surgery*, **6**, 568-574, August, 1924. (2 cases.)
- ¹⁵⁵ Müller, W.: Madelung'scher Deformität des Handgelenkes. *Zentralblatt für Chirurgie*, **34**, 1333-1334, 1907. (Same case as Franke,⁸⁷ *q.v.*)
- ¹⁵⁶ Natvig, Reinhardt: Madelung's Haanddeformitet. *Tidsskrift for dem norske Laegeforening*, **25**, 535-555, 1905. (1 case.)
- ¹⁵⁷ Nélaton, A.: Luxations du Poignet. *Elemens de pathologie chirurgicale*, Paris 1847-1848, **2**, 405-412. (Description too vague for acceptance.)

- ¹⁵⁸ Nélaton, Ch.: Luxations Radio-carpiens. *Traité de Chirurgie, de Duplay et Reclus*, 3, 121-125, 1897. (1 case, described on pages 124-125, is a dissected specimen.)
- ¹⁵⁹ Nové-Josserand, G.: La maladie de Dupuytren-Madelung. Seventeenth International Congress of Medicine, London, 1913, 7, Part 1, Orthopedics, 206-208. (Brief discussion; no case report.)
- ¹⁶⁰ Ollier, L.: *Traité expérimental et clinique de la régénération des os et de la production artificielle du tissu osseux*. Paris, 1877, 1, 402. (Basis for Dalbera's⁵⁸ work on Ollier's Law.)
- ¹⁶¹ Ollier, L.: *Traité des Resections*, 1, 408, 1885 (Curved radius due to resection of cartilage); 2, 441, 1889. (Deformity secondary to osteitis of the lower end of the radius.)
- ¹⁶² Painter, Chas. F.: Congenital Dislocation of the Carpus. *Bryant and Buck's American Practice of Surgery*, 4, 742-746, 1908. (Description meager; apparently an ulnar deformity.)
- ¹⁶³ Palazzi, G.: Contributo alla cura operatoria della Deformità di Madelung. *La Clinica Chirurgica*, 12, 805-814, 1909. (1 case.)
- ¹⁶⁴ Parkes, William R.: Madelung's Deformity of the Wrist. *Illinois Medical Journal*, 27, 286-288, April, 1915. (1 case.)
- ¹⁶⁵ Peckham, Frank E.: Report of a Case of Congenital Deformity of the Wrist Joints. *American Journal of Orthopedic Surgery*, 4, 388-389, 1907. (1 case.)
- ¹⁶⁶ Peckham, Frank E., and Hammond, Roland: Madelung's Deformity. *Boston Medical and Surgical Journal*, 160, 447-448, April 8, 1909. (1 case; Case 3 acceptable; Case 4 too vague.)
- ¹⁶⁷ Pedrazzi, Carlo: Deformità di Madelung familiare. *La Radiologia Medica*, 14, 125-132, February, 1927. (2 cases.)
- ¹⁶⁸ Pels-Leusden: Madelung'sche Deformität der Hand. *Freie Vereinigung der Chirurgen Berlins. Zentrablatt für Chirurgie*, 34, 190, 1907. (1 case.)
- ¹⁶⁹ Pels-Leusden: Über die Madelung'sche Deformität der Hand. *Deutsche Med. Wochen.*, 33, 372-374, 1907. (1 case.)
- ¹⁷⁰ Perrin: Exostoses osteogeniques multiples accompagnées d'arrets de développement et de déformations du squelette. *Revue d'Orthopédie*, 5, 53-82, 1914. (Deformities due to exostoses.)
- ¹⁷¹ Pilatte, René: Contribution à l'étude du radius curvus. *Thèse de Paris*, 134, 1919. (3 cases.)
- ¹⁷² Pilatte, René: Sur la pathogénie du radius curvus. *Revue d'Orthopédie*, 8, 223-224, 1921. (Discussion.)
- ¹⁷³ Piollet: Un cas de radius curvus. *Bulletin de la Société de Chirurgie de Lyon*, 9, 274-277, July 5, 1906. (1 case.) *Lyon Med.*, 107, 799, 1906. (Same case.)
- ¹⁷⁴ Poncet, Antonin, et Leriche, René: Tuberculose inflammatoire et rachitisme tardif. *Bull. de l'Acad. de Médecine*, 58, 214-221, 1907. (Deformities secondary to tuberculosis.)
- ¹⁷⁵ Poncet, Antonin, et Leriche, René: La Maladie de Madelung. Ses modalités, sa pathogénie. *Gazette des Hôpitaux*, 82, 187-191, February 9, 1909. (Discussion of deformity; cases as reported above.¹⁷⁴)
- ¹⁷⁶ Pooley, J. H.: Congenital Dislocation of the Wrists. *The American Practitioner of Medicine*, 21, 216-220, 1880. (1 case.)
- ¹⁷⁷ Poucel: Carpus Curvus. *Séance de la Société de Chirurgie de Marseille*, November, 1929. *La Presse Médicale*, 38, 24, 1929. (Description too meager for acceptance.)
- ¹⁷⁸ Poulsen, Kr.: Über die Madelung'sche Deformität der Hand. *Archiv für Klinische Chirurgie*, 75, 506-532, 1905. (2 cases.)
- ¹⁷⁹ Putti, Vittorio: La deformità di Madelung. *Archives Internationales de Chirurgie*, 3, 64-98, 1906. (1 case.)
- ¹⁸⁰ Putti, Vittorio: Sulla deformità di Madelung. *Comunicazioni V Congresso della Società Ortopedica Italiana, Archivios di Ortopedia*, 25, 469, 1908. (Discussion.)

- ¹⁸¹ Putti: Sur la malformation de Madelung. *Revue d'Orthopédie*, **10**, 207-220, 1909. (1 case, museum specimen.)
- ¹⁸² Quadrone, Carlo: Contribution à l'étude de la Maladie de Madelung (Subluxation spontanée de poignet). *Nouvelle Iconographie de la Salpêtrière Paris*, **24**, 71, 1911. (1 case.)
- ¹⁸³ Quarenghi, F. M.: Contributo allo studio della cosi delta Malattia di Madelung. *Pensiero Med.*, Milano, **13**, 57, 1918. (Not obtainable.)
- ¹⁸⁴ Raconski, F. E.: Madelung'sche Deformität; Cas. Soplek. *Cesk.*, **14**, 125, July 15, 1927. (Apparently a traumatic case. Not obtainable.)
- ¹⁸⁵ Ramos, Alvaro: A proposito de dois casos legitimos da deformação de Madelung. *Archives Brasileiros de Medicina*, **1**, 1, 1911. (Case 1, Madelung; Case 2, rickets.)
- ¹⁸⁶ Redard, P.: Sur un déformation rare du poignet. *Archives Générales de Médecine*, **30**, 651-667, 1892. (1 case.)
- ¹⁸⁷ Redard, P.: Difformité Congénitale rare des avant-bras. Synostoses radio-cubitales. *Radius Curvus*. *Revue d'Orthopédie*, **9**, 113-119, 1908. (Elbow deformity due to synostoses.)
- ¹⁸⁸ Reich: Cited by Beder, Rocher, Cserey-Pechany, Claiborne and Dimitriu. (We have been unable to find the articles under any of the references quoted.)
- ¹⁸⁹ Ricq: Pathogénie du radius curvus. Thèse de Lyon, 1908. (Not obtainable.)
- ¹⁹⁰ Robert, César Alphonse: Des vices congénitaux de conformation des articulations. Thèse au concours, 1851. (Not obtainable.)
- ¹⁹¹ Robinson: De la carpo-cyphose. *Gazette des Hôpitaux*, **81**, 1781, 1908. (No new case report.)
- ¹⁹² Robinson, R., et Jacoulet, F.: La luxation congénitale de l'extrémité inférieure du cubitus. *Archives Générales de Chirurgie*, **3**, 1-30, 1909. (2 cases; Case 2 dissected.)
- ¹⁹³ Rocher, H. L.: Radius curvus symptomatique d'une ostéite fibreuse de la moitie inférieure du radius droit. *Gazette Médicale de France*, **10**, 437-439, May 15, 1935. (This is not a true Madelung's deformity, but secondary to osteitis.)
- ¹⁹⁴ Rocher, H. L.: À propos de notre septième observation de Maladie de Madelung; Dyschondroplasia radio-cubitale inférieure par hémiatrophie epiphysaire radiale interne. *Journal de Médecine de Bordeaux*, **114**, 513-518, April 17, 1937. (1 case.)
- ¹⁹⁵ Rocher, H. L.: Maladie de Madelung. *Traité de Chirurgie Orthopédique*, de Ombrédanne et Mathieu, Paris, 1937, **3**, 28485-28489. (Reference book description and discussion.)
- ¹⁹⁶ Rocher, H. L., et Canton, J.: Pathogénie de la difformité de Madelung. *Journal Med. de Bordeaux*, **112**, 676-678, September, 1935. (Discussion; no new case.)
- ¹⁹⁷ Rocher, H. L., et Rocher, Christian: La Maladie de Madelung; Dyschondroplasia Radio-cubitale Inférieure Conditionnée Essentiellement par l'Hémiatrophie Epiphysaire Radiale. *Chirurgia degli Organi di Movimento*, **20**, 20-30, 1934. (1 case; Case 2 described previously.)
- ¹⁹⁸ Rocher, H. L., et Roudil, G.: Dymorphose congénitale bilaterale des poignets par hémiatrophie epiphysaire radiale. *La Presse Médicale*, **38**, 1089-1090, August 13, 1930. (1 case.)
- ¹⁹⁹ Roederer, C.: Un cas de maladie de Madelung larvée. *Bull. et Mém. de la Soc. de Chir. de Paris*, **20**, 235-237, March 16, 1928. (1 case; Case 2 too brief for acceptance.)
- ²⁰⁰ Roget, Eugene: Étude sur le radius curvus. Thèse de Lyon, **121**, April 26, 1899. (1 case.)
- ²⁰¹ Roos, E.: Über späte Rachitis. *Zeitschrift für Klinische Medizin*, **48**, 120-144, 1903.
- ²⁰² Roudil, G. Drevon, et Mourgues: Dymorphose congénitale bilaterale des poignets (Maladie de Madelung). *Journal de Radiologie et d'Electrol.*, **20**, 241-245, April, 1936. (1 case.)
- ²⁰³ Salisachs, Louis Gubern: Contribuçon al estudio de la deformidad de Madelung.

- Revista Médica de Barcelona, 20, 105-137, August, 1933. (Case 1, fracture; Case 2, rickets; Cases 3, 4 and 5 acceptable.)
- ²⁰⁴ Sauer, F.: Die Madelung'sche Deformität des Handgelenkes. Beiträge zur Klin. Chir., 48, 179-203, 1906. (3 cases.)
- ²⁰⁵ Savariaud: Maladie de Madelung-Duplay ou subluxation progressive et spontanée du poignet par radius curvus chez une jeune fille atteinte d'ostéite spécifique. La Presse Médicale, 21, 592, 1913. (Case not accepted due to too meager description.)
- ²⁰⁶ Schade, A.: Kasuistischen Beiträge zu den Luxationen im Handgelenke auf Grund pathologischer Zustände. Inaugural Thesis at Kiel, 1906. (1 case.)
- ²⁰⁷ Schnek, Fritz: Die operative Besserung der echten und der sogenannten symptomatischen Madelung'schen Deformität. Zeitschrift für Orthopädische Chirurgie, 1, 320-329, October 14, 1928. (Case 1, Madelung's deformity; Case 2, osteomyelitis; Case 3, Madelung's deformity.)
- ²⁰⁸ Schnek, Fritz: Federne dorsalluxation de Elle Konsulensradius. Madelung'sche Deformität. Zeitschrift für Orthopädische Chirurgie, 52, 101-110, May 2, 1930. (Discussion.)
- ²⁰⁹ Schulze, H.: Ein Fall von spontaner subluxation der Hand nach unten (Dupuytren-Madelung'scher Subluxation). Münchner Medizinische Wochenschrift, 52, 1441-1443, 1905. (1 case.)
- ²¹⁰ Scoutetten: Luxations du poignet. Bulletin de l'Académie Royale de Médecine, 6, 796-804, 1840. (Lecture on traumatic and occupational dislocations and fractures at the wrist.)
- ²¹¹ Siegmund, Erwin: Isolierte volare luxation des Ulnaköpfchens. Zentralblatt für Chirurgie, 55, 1742-1745, 1928. (This case is too doubtful for inclusion as genuine.)
- ²¹² Siegrist, Hans: Über Manus valga oder sogenannte Madelung'sche Deformität des Handgelenkes. Deutsche Zeitschrift für Chirurgie, 91, 524-586, 1908. (3 cases.)
- ²¹³ Smith, Robert William: Treatise on Fractures in the Vicinity of Joints and on Certain Forms of Accidental and Congenital Dislocations. New York & Dublin, 1854, Chapter vii, 238-255. (Describes Cruvelhier's⁴⁹ case and one of his own. Both are secondary deformities.)
- ²¹⁴ Solberg, M.: To tilfaulde af Madelungs haanddeformitet. Tidsskrift for den norske Laegeforening, 24, 195-196, 1906. (2 cases.)
- ²¹⁵ Sorrel, M.: Radius curvus Opéré. La Presse Médicale, 33, 189-190, February 11, 1925. (Description too meager for acceptance as a genuine case of Madelung's deformity.)
- ²¹⁶ Springer, Carl: Zur Kenntnis der Madelung'schen Deformität des Handgelenkes. Zeitschrift für Orthopädische Chirurgie, 29, 216-251, 1911. (Case 1, osteomyelitis; Cases 2, 3 and 4, Madelung's deformity.)
- ²¹⁷ Springer, Carl: Zur Entstehung der Madelung'schen Handgelenksdeformität. Verhandlungen der Deutschen Gesellschaft für Orthopädische Chirurgie, 10, 212-219, 1911. (Discussion.)
- ²¹⁸ Springer, Carl: Zur Operation der Madelung Deformität. (Korrektur der Gabelhand durch Osteotomie und Supination Depronation.) Zeitschrift für Orthop. Chir., 33, 590-601, 1913. (Operative description.)
- ²¹⁹ Standard Classified Nomenclature of Disease. 2nd Edit., New York, 1935. Also see J.A.M.A., 110, 509-511, February 12, 1928.
- ²²⁰ Stetten, DeWitt: Zur Frage der sogenannten Madelung'schen Deformität des Handgelenkes mit besonderer Rücksicht auf eine umgekehrte Form derselben. Zentralblatt für Chirurgie, 35, 949-952, 1908. (1 case.)
- ²²¹ Stetten, DeWitt: Idiopathic Progressive Curvature of the Radius or So-called Madelung's Deformity of the Wrist (Carpus Varus and Carpus Valgus). Journal of Surgery, Gynecology and Obstetrics, 8, 4-31, January, 1909. (Same case as reported above.²²⁰)

- ²²³ Stieda, A.: Verein für wissenschaftliche Heilkunde in Königsberg. Deutsche medizinische Wochenschrift, **30**, 989-990, 1907. (1 case.)
- ²²⁴ Stokes, A. C.: Spontaneous Forward Dislocation of the Wrist Joint (Madelung's Deformity). ANNALS OF SURGERY, **52**, 229-238, 1910. (2 cases.)
- ²²⁵ Tancredi, G.: Sulla deformità di Madelung (Contributo alla cura chirurgica). Bullettino e atti della Reale Accademia di Roma, **57**, 153-158, June, 1931. (1 case.)
- ²²⁶ Taylor, H. L.: Progressive Curvature of the Radius (Madelung's Deformity) Corrected by Osteotomy. Medical Record, **82**, 752-755, October, 1912. (2 cases.)
- ²²⁷ Tillier, Robert: Sur la Pathogénie du Radius Curvus. Lyon Chirurgical, **17**, 739-743, 1920. (Discussion; no case report.)
- ²²⁸ Tollas, Helmut: Zur Ätiologie der Madelung'schen Knochenerkrankung an der Hand eines selbstbeobachteten Falles. Archiv für Kinderheilkunde, **82** 112-114, September, 1927. (1 case.)
- ²²⁹ Tomescu, Ion: Ein Fall einer atypischen Madelung'schen Handgelenksdeformität. Fortschritt a. dem Geb. d. Roentgenstrahlen, **36**, 627-629, September, 1927. (Not a true deformity.)
- ²³⁰ Trillmich: Beitrag zur Madelung'schen Deformität. Zeitschrift für Orthopädische Chirurgie, **31**, 69-80, 1913. (Case 1, rickets; Case 2, vague.)
- ²³¹ Trippier, Leon: Supposed to have inspired the thesis of Félix.⁸¹ Although frequently cited, no pertinent article is found of his own.
- ²³² Vianna, Barboza: Doença de Madelung. Folha Med., **12**, 241-251, July 25, 1931. (1 case.)
- ²³³ Vidal, Carlota: Sub-luxação de Madelung-Duplay (carpus curvus). Lisboa Medica, **6**, 219-239, April, 1929. (2 cases; Cases 1 and 2 are genuine; Case 3 is traumatic.)
- ²³⁴ Vigyázógy: Madelung's Deformity of the Hand. Orovsi Hetilap, Budapest, **47**, 450-474, 1913. (Not obtainable.)
- ²³⁵ Volkmann, Th.: Über Madelung'sche Subluxation nach vorne. Inaugural Dissertation, Leipzig, 1905. (2 cases.)
- ²³⁶ Weber, Carl Otto: Chirurgie Erfahrungen und Untersuchungen nebst zahlreichen Beobachtungen aus der chirurgischen Klinik und dem Evangelischen Krankenhaus zu Bonn. Berlin, 1859, 232. (Case later operated upon by Busch.⁸⁵)
- ²³⁷ Wéry: Deux cas de Maladie de Madelung. Bruxelles Médicales, **2**, 45-46, 1921. (2 cases.)
- ²³⁸ Wittek: Zwei seltene Verletzungen im Bereiche der Handwurzel. Archiv für Orthopädische, Mechanotherapie, und Unfall Chirurgie, **1**, 101-107, 1903. (Cases of fracture.)
- ²³⁹ Wright, Louis T., and Kaufman, Justus: Unusual Type of Madelung-like Deformity. American Journal of Surgery, **34**, 365-368, 1936. (This is an ulnar dyschondroplasia, not radial.)
- ²⁴⁰ Zeitlin, A.: Morbus Madelung oder Madelung'sche Deformität. Zentralblatt für Chirurgie, **57**, 929-932, April 12, 1930. (No case report.)