

A BONY SUPRACONDYLOID FORAMEN IN MAN.
WITH REMARKS ABOUT SUPRACONDYLOID AND OTHER PROCESSES
FROM THE LOWER END OF THE HUMERUS.

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WITH 1 PLATE.

This foramen (Fig. 1) which, so far as I know, is unique in literature, occurs in the left humerus from the body of a white woman aged 57. There is neither supracondyloid foramen nor process on the right one. Otherwise the humeri are very symmetrical, and present no signs of pathological ossifications. The length of each is 28.5 cm. The angle of torsion of the right humerus is 157 degrees, and on the left 160 degrees. The process inclosing the foramen springs from the inner surface about midway between the internal and anterior borders 62 mm. above the lowest part of the trochlea. It arises by an extremely thin triangular expansion, about 1 cm. broad from above downwards, and is continued as a slightly convex arch 32 mm. long, measured on the convexity, to end in another triangular expansion some 4 mm. broad on the anterior surface of the internal condyle, 2 cm. above its lower border. The foramen, therefore, is bounded wholly by bone. The process is an extremely delicate structure, especially in the upper two thirds, where its thickness is that of paper. The lower end is from 1 to 2 mm. thick. The process is twisted in its course, the expansion at its origin facing outward and forward, and that at its end forward and inward. The thinner part above passes into the thicker part below without any change of character.

The median nerve ran through the foramen. The brachial artery passed over the origin of the process. The brachial artery and its branches were very small; the anterior circumflex was very minute, possibly represented by two twigs, the posterior circumflex was represented by a branch from the superior profunda. At about the usual place of division the brachial gave off a radial artery of about half the diameter of the ulnar, which latter seemed to be the direct continuation. The

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median nerve arose in the usual manner, but at about the middle of the arm passed *behind* the brachial artery from without inwards, and at the lower third became separated from it. It passed through the foramen, lay between the pronator radii teres, and the brachialis anticus, and entered the forearm between the two heads of the pronator. The origin of this muscle was continued into the lower third or more of this process while the brachialis anticus received fibres from about a corresponding area at the upper end, the middle of the arch having no muscular fibres and appearing as a white line.

There can be no question that this bony arch represents the process with its fibrous continuation which bounds the occasional opening in man representing the widely distributed supracondyloid foramen of animals. (I may mention in passing that the fibrous band is not constant. My experience in this respect agrees with that of Nicholas (1)). In the first place the process that bounds the foramen occurs at the normal point of origin of the supracondyloid process. This, according to Otto (2), is in a line from the inner border of the trochlea to the anterior border of the greater tuberosity. Testut (3) accepts this and adds another line of his own from the groove in the trochlea (*gorge de la trochlée*) to the middle of the articular surface of the head. In point of fact the course of these lines must be far from constant; but if both these statements be correct, as they approximately are, the process must be at the point of intersection of these lines. Although this is true, the process is lower than usual. I have said it arises 62 mm. above the lowest point of the inner border of the trochlea, the measurement being taken from the highest point of the origin of the process. Testut gives the average distance of eight cases as 71 mm. and Nicholas that of six as 73 mm. Moreover, the latter, at least, placed his starting point at the middle of the base of the process. Ruge (4) declares that according to all experience the position is a constant one; which is practically in accord with my own less extensive observations. There are, however, certain exceptions to be mentioned later. Another important fact is that the median nerve passes through the foramen, *i. e.*, under the process. It may be asked whether this is a real foramen; that is to say: was the strip of bone bridging it over either laid down in cartilage or formed by the early ossification of the completing band, in contradistinction to a quasi-accidental ossification of that band in adult life? In other words, have we at last found the supracondyloid foramen in man? I incline very strongly to consider it a real foramen, and probably one formed by a cartilage. The process usually, when it is more than a ridge or a tubercle, is thick at its base and narrows to the point which

may or may not expand into a knob. It is much stronger than the ligament continuing it. Here, on the contrary, the border of the foramen is thicker below than above. So far as I can remember, all the connecting bands which I have seen, or of which I have seen figures, run straight or even in a concave line to the inner condyle; this, on the contrary, is convex. It is worth noting that in the few supracondyloid processes which have been observed in children ossification begins very early. Thus Macalister (5) mentions a specimen in the Cambridge Museum from a child 27 months old, in which the process is 3 mm. long, and both it and the faint ridge above are ossified. Cunningham (6) has seen the process in both arms of a child of three: on one side 4 mm. long, on the other 3 mm., and both completely ossified. More remarkable still, he has seen it in both arms of a full-time still-born child. "In both bones the process is 5 mm.; and further, it is fully ossified from base to tip. From this it would appear that the supracondyloid process is ossified along with the diaphysis, and from the same center; and further, that its ossification is completed at an extremely early date." There is, I think, every reason to believe that this arch was originally cartilaginous. The case most nearly approaching this, which I am acquainted with, is that reported by Tandler (7). It was also found on the left arm of a woman. The arch, which was bony in the middle and fibrous at both ends, passed over both the artery and the nerve. This implies an early cartilaginous arch incomplete at the ends.

A very thorough examination of the literature has failed to reveal the record of any similar case in man. It is perhaps less surprising that it has now been observed than that it has not been observed sooner.¹

A rather curious paper by Solger (8) has raised the question whether all processes which at first sight seem to be supracondyloid have the same significance. He describes a process which he calls *anterior sive medius* about 1 cm. long, hooklike, and directed *inwards*, arising about 4 cm. above the capitellum (capitulum), from which a dense cord of fat,

¹ It is hardly conceivable that any anatomist who should have met with such a specimen should not have made it public. I am told by a competent anatomist that he saw a foramen several years ago in a laboratory in Vienna. It was also reported to me on the authority of a student that there is a similar specimen among the Indian bones in the Peabody Museum at Cambridge. With the kind help of Dr. Farabee of the Museum I searched for it in vain for some three hours. Dr. Farabee thought that we examined nearly a thousand humeri. I should hardly dare to place the number so high; but it is worth noting that among several hundred Indian bones we found only two instances of a supracondyloid process, one of which was small, and the other smaller. I imagine that the foramen seen by the student was above the trochlea.

which he considers an accessory head of the muscle, ran into the brachialis. The pronator teres, the vessels and the median nerve showed no peculiarity. According to him, "Such abnormal processes with abnormal prolongations of the muscles attached to them may spring, as is well known, from various parts of the diaphysis above the inner condyle." Solger considers this and two or three others, which he thinks he has found in literature, as intermediate between the internal supracondyloid process and the rare external one. The cases he refers to are two out of five reported by Gruber (9), and one out of four reported by Turner (10). Having consulted the original papers, I am far from convinced. Gruber himself says that his five new cases presented the same or similar features as the preceding forty-two. Turner states distinctly that in all four cases the process arose from the inner part of the shaft, and that in all the median nerve passed under it. Perhaps the most important peculiarity of one of his cases, presumably the one referred to, is that no fibres of the pronator came from the process nor from the band. The situation of the process in Solger's own case is certainly very remarkable, but I cannot see that the cases he cites belong with it. On the other hand, Bertaux (11) in the same year reported three cases which seem to support Solger's views. Unfortunately there is no account of the soft parts. Two of the specimens are from the same skeleton. The right process is flattened and triangular, with a long base, continuous above with the anterior border of the bone,² and prolonged below to the inner border of the coronoid fossa. The upper and lower borders of the process are so symmetrical that it points neither upward nor downward, but is turned inward so as to form something of a gutter. The left one is similarly placed but is larger and with less symmetrical borders, the upper one being more nearly horizontal and also rougher. The third instance is unilateral, on the left arm of a man of 27. The process has the usual appearance, extending hook-like downwards and inwards, the only important peculiarity being that it seems to be continuous with the anterior border. Peculiar processes, not easy to interpret, certainly arise in this region.

The following instance is, perhaps, worth reporting, though unfortunately I have no data beyond those offered by the macerated humerus recently added to the Warren Museum. The specimen (Fig. 2) came from a white man aged 50, who evidently was of very powerful frame. The humerus is strong, and the muscular ridges well developed. The

² "Elle semble s'insérer sur un dedoublement du bord antérieur, soulevé fortement a ce niveau."

anterior border of the humerus, instead of subsiding as it approaches the lower end, becomes more and more prominent and is continued into a stout process slanting downwards, forwards and somewhat inwards to end free above the inner half of the trochlea. The vertical distance from the under side of the root of the process to the level of the lowest point on the inner border of the trochlea is 4 cm. The lower border of the process measures 16 mm. It is more difficult to measure the upper border, as it has no definite beginning. It may be said to be about 25 mm. The process is compressed from side to side, the vertical diameter being about 11 mm. and the transverse about 6. It is somewhat enlarged at the free end, which is rough and irregular, and rather suggestive of having been covered with non-articular cartilage; the bone is otherwise healthy, but the shape at the lower end is modified by the exaggeration of the anterior border, which is, as it were, pulled forward by this process. The posterior surface of the bone shows the effect of the distortion, being hollowed above the olecranon fossa to a remarkable degree. This very certainly is a congenital malformation, and no post-partum pathological exostosis. If it made a foramen at all it must have been by some connection with the ulna, but the appearance of the joint does not indicate any limitation of motion. It is hardly conceivable that it formed any connection with the internal condyle. Its inner aspect is slightly grooved as if it may have rested against the artery and nerve. It certainly is not an internal supracondyloid process. It might be called an anterior or middle one, were the term considered justifiable. Gruber would have called it a false internal supracondyloid process. I cannot help thinking that Poirier (12) must have met with some such process as this when he speaks of having witnessed the removal of a supracondyloid process that interfered with the motion of the joint. It is not credible that the ordinary supracondyloid process should do this.³ The same may be said of processes which are easily felt during life. I examined the body on which this foramen was found before dissection with a special view to supracondyloid processes without detecting anything uncommon.

I hesitate to agree with Solger in considering this as intermediate between the internal supracondyloid processes and the "much rarer external ones." I do not admit a *middle supracondyloid process*. Ber-

³ "J'ai pu sentir l'apophyse sur le cadavre entier et j'ai vu, à Londres dans le service de Lister, enlever une apophyse très développée qui, faisait saillie sous la peau et gênait les mouvements du coude: il fallut détacher les faisceaux du rond pronateur qui s'inséraient sur le crochet osseux."

taux's observations prove, however, that the position of the usual process is not fixed. Is it possible that it may wander so far as to appear over the external condyle?

The *external supracondyloid process* rests, so far as I know, on the solitary observation of Barkow (13). It is not surprising that though the reference to Barkow's paper is common enough, few seem to have any definite idea of what he described, as his observations are not easily accessible. Having had the advantage of seeing the original, which is in the Surgeon-General's Library at Washington, I give a photograph (Fig. 3) of his figure so that others may judge for themselves of this process. Gruber (14) is very severe in his criticisms of Barkow. The process, he says, is neither in the place it should occupy were it the analogue of the process in mammals it is held to represent; it is in no relation to the radial (musculo-spiral) nerve; it points downwards instead of upwards. I am not quite convinced that it is impossible that the nerve should pass under this process, though it certainly is placed below the usual course of the nerve. It is probable that it is a mere irregular ossification of the external supracondyloid fibrous tissue; but after all it has a decided resemblance to the internal supracondyloid process. I believe that it is of no significance.

In conclusion I would say something as to the explanation of the occasional appearance of the supracondyloid process or foramen in man, much discussed as this question has been. I had the honor of reading a paper on the "Significance of Anomalies" before the Association of American Anatomists in 1894 (15). One of the instances I chose was the supracondyloid process. While I could offer no satisfactory explanation, it seems to me that I showed well-nigh insuperable objections to the common plan of calling them reversions. I then said, "It is clear that if an anomaly in man is to be called a reversion, either the species in which it is normal must have been in the direct line of ancestry, or there must have been a common progenitor." I am inclined now to add that it is reasonable to expect that this common progenitor should be, as one may say, somewhere within call. I also laid stress on the argument that similarity of structure does not necessarily imply common descent; and this is true when we consider the normal structure of animals of different orders, or even I may say of different classes, as well as the variations. Very valuable work has been done by distinguished colleagues since then. Professor Huntington (16) has emphasized the occurrence of such phenomena and has stated the matter with great clearness. Treating of muscular variations he distinguishes three kinds. *Archeal* reversional variations repeat conditions which are not found in

the mammalia, but which appear homologous with structures in other vertebrates and indicate a reversion to the common vertebrate type antecedent to class distinctions. Less far-reaching are *progonal* reversional variations in which the observed structure is normal in no species of that order, and consequently points to the common class stem. *Ataval* reversional variations represent structures which though not normal in the species in question exist in species of the same order. The supracondyloid process, according to him, belongs to the first of these classes; but the question at issue is, whether this method affords any solution of the difficulty. Now the possibility of a reversion is not in the slightest established by calling it archeal; on the contrary it may be said that by defining the dimensions of the gulf to be passed the probabilities of a leap over it become less conceivable. In short, according to the general teaching, it seems to be claimed that putting aside alleged progressive variations and such as for want of a better word may be called accidental, there is no principle to account for variations save reversion. But the difficulty is not yet fully stated; for the problem is not to account for the supracondyloid process only, but for all the variations of bone, muscle, viscus, etc., that occur in man or in any animal. So far as they have been studied we do not find any universal concurrence in the evidence; and yet it is essential to the theory that there should be no contradictions. I have from the first been much impressed by the passage in the late Lord Salisbury's (17) Oxford address concerning Mendeléeff's law according to which "elements can be divided into families of about seven, speaking very roughly: that those families all resemble each other in this, that as to weight, volume, heat, and laws of combination the members of each family are ranked among themselves in obedience to the same rule. Each family differs from the others, but each internally is constructed upon the same plan." What was a weakness in this theory "was turned into strength," to quote again his words, by the discovery of certain elements which were wanting in some of the groups when the law was first announced. He continues: "If these were organic beings all our difficulties would be solved by muttering the comfortable word 'evolution'—one of those indefinite words from time to time vouchsafed to humanity, which have the gift of alleviating so many perplexities and masking so many gaps in our knowledge." Physics not being in my line, I thought it advisable to inquire of an authority whether this were correct, and was assured in reply that Mendeléeff's law had been confirmed and strengthened since Lord Salisbury's address and is now used as the working hypothesis. If, then, we have such curious resemblances in non-organic nature, why should the mere fact of life put aside the possi-

bility, or rather the probability, of an analogous state of affairs in animals? We find similarity of plan where inheritance is excluded, ergo inheritance is not the sole cause of similarity, whether we deal with the normal condition or with variations. The old idea of type, abused and made ridiculous as it has been, is not all error.

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EXPLANATION OF FIGURES ON PLATE I.

FIG. 1.—Supracondyloid foramen seen not directly from the front, but a little from the outside.

FIG. 2.—Peculiar process from anterior border. Inner aspect.

FIG. 3.—Barkow's "external supracondyloid process."

