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SUCCESSFUL REMOVAL
OF THE
ENTIRE UPPER EXTREMITY FOR OSTEO-
CHONDROMA.

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On the recommendation of Dr. de Denne, of Cradley, a carter, æt. 40, was admitted into the General Hospital, Birmingham, January 16th, 1889, under my care, for a large tumour growing from the right humerus which ten years before had been first noticed below and external to the shoulder-joint. In spite of treatment the growth was steadily maintained, and the increase in size caused pain in the neck and forearm, but it was only during the last eighteen months that the surface became irregular and the growth perceptibly more rapid.

Three months before admission softened patches appeared at the lower part, and one week previously one such patch had given way and an oily fluid constantly drained from the opening. Up to the last the affected arm, with the aid of a sling, was used for driving, and there was no deterioration of the general health.

On admission.—A tumour twelve inches long, with a cir-
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cumference of twenty-eight inches at its widest part and resting internally upon the thoracic wall, was found implicating the shaft of the humerus from a point immediately above the condyles, but the shoulder-joint was moveable.

Its surface was very irregular, and presented numerous bosses and depressions; most of the prominences were quite hard, but at the upper and outer aspect there was a fluctuating area, and at the lower part an ulcerated surface the size of a shilling. Numerous large dilated veins were seen running over the tumour.

The various internal organs of the body were apparently healthy.

January 19th.—There was a free oozing of venous blood from the ulcerated surface, but it was arrested by the application of an ice-bag, until the early morning of the 21st, when the hæmorrhage became so free that the ice failed to exert any beneficial influence, and the house surgeon was obliged to resort to the thermo-cautery. This reduced the bleeding to a slight ooze.

At 11 a.m. (January 21st) the following operation was performed :

Subperiosteal resection of the middle third of the clavicle by means of an incision carried along its shaft from the sterno-mastoid muscle to the acromion process of the scapula. The original intention was to tie the third part of the subclavian artery and vein with double ligatures, but, owing to free venous oozing resulting from division of some of the dilated veins, the first part of the axillary vessels were laid bare by carrying an incision from the middle of the clavicular one down the inner side of the tumour, and then backwards to the tip of the angle of the scapula, reflecting inwards the skin and dividing the pectoral muscles. The vessels were then divided, after the application of double silk ligatures, and the cords of the brachial plexus, together with the muscles forming the posterior axillary fold, severed. By turning the patient on the sound side and drawing the affected arm

across the chest, a posterior flap was formed by making an incision from the tip of the acromion process backwards to the angle of the scapula, and reflecting the skin to the posterior border of the bone. A division of the muscles attached to its upper and posterior borders permitted the removal of the scapula, the outer third of the clavicle, and the arm, *en masse*.

The exposed surfaces were irrigated with corrosive sublimate lotion, and the flaps brought together without tension by silver wire sutures. A dressing of iodoform and corrosive sublimate wool was applied, and the patient removed to bed.

By the following day (January 22nd) he had quite recovered from the effects of shock, and took light nourishment freely.

February 7th.—The upper portion of the wound had healed and the lower was granulating rapidly, but in the afternoon the patient, who had been sitting up in bed, experienced a shooting sensation in the wound, and immediately afterwards the dressings and adjacent bed-linen were found saturated with blood, the man becoming blanched and collapsed. The dressings were at once removed, but the wound presented no bleeding point, merely two small clots were visible in the position of the artery. An anæsthetic was administered, and the wound enlarged at its upper end by an incision an inch and a half long, parallel to the cicatrix of the former wound. It was then seen that the axillary artery was merely plugged with a small clot; this becoming dislodged a gush of blood took place. An aneurism needle, with a stout silk ligature, was then passed round the artery as it lay embedded in a mass of granulation tissue, and having been tied the ends of the silk ligature were left long.

On the 12th, the patient having completely rallied, as the pulsations of the artery were quite distinct down to the ligature, it was deemed prudent to reopen the wound made on the 7th, to saw off half an inch from the end of the clavicle, divide the deep cervical fascia and

secure the subclavian artery immediately behind the scalenus anticus. A silk ligature, with the ends left long, was employed.

The progress of the case from this date was uninterrupted.

On February 14th the ligature came away from the first part of the axillary artery in a very sloughy condition, but that from the subclavian did not separate until February 24th.

On March 6th the patient was able to get up, but for some time experienced a good deal of difficulty in balancing himself.

April 25th.—Dismissed.

Up to the present time (June, 1890) he has remained well and become considerably stouter.

The limb in its entirety was forwarded to Mr. Charles Cathcart, of Edinburgh, for the purpose of a cast being made according to his own method; and when that had been done to make a section of its growth. His report is as follows:

“The preparation consisted of the right upper limb, including the scapula and part of the clavicle, of a man. The weight of the preparation was 21 lbs.; that of the tumour about 18 lbs. The circumference of the tumour at its widest part was twenty-eight inches. The tumour was nodular in outline and of a firm elastic consistence, except at one or two places where it had softened and become cystic. In cutting the tumour the knife was greatly obstructed by calcareous nodules, and the saw and knife had to be used alternately.

“*Naked-eye appearance of fresh section.*—The tumour consisted essentially of nodules of clear cartilage, varying in size from that of a pea to that of a walnut. The smaller nodules were firm and transparent, like the substance of a crystalline lens. The larger ones were yellowish and somewhat opaque, and in some cases had softened in the centre. Round the nodules there was a delicate stroma of connective tissue containing blood-vessels.

“From the blood-vessels a deposit of calcareous salts had taken place in the periphery of the nodule, in some cases surrounding the nodule with a calcareous shell. Here and there, where several calcareous nodules in close proximity had formed a large mass, the structure of cancellated bone was distinctly visible, ossification having taken place.

“The upper and outer portions of the shaft of the humerus were thickened and sclerosed. The interior of the bone was apparently unaffected.

“Judging, therefore, from the specimen, the tumour would seem to have started from the periosteum at the upper end of the shaft of the humerus, towards the back and outer side ; afterwards to have grown more and more away from the bone, pushing the soft parts before it.”

Microscopically the tumour was found to be composed of hyaline cartilage, with no features of special interest.

Removal at one operation of the entire upper extremity and part of the clavicle, as a method of treatment in cases of neoplasmata situated in the region of the shoulder-joint, was first practised in 1838. From that date to 1863 four records only have been published. But since Mr. Syme's case in May of the last-named year there has been a steady increase in the number of records, and the operation is now a recognised procedure ; a table of forty-four operations is herewith appended.

In 1882 M. Paul Berger, as the result of his observation and experimental investigations, was led to suggest that the operation should be systematically performed as follows :

1. Resection of the middle third of the clavicle. Professor Ollier in 1884 suggested that, as a safeguard against wounding the vessels, the resection should be made subperiosteally.¹ This he successfully performed, but Mr.

¹ Practically the subperiosteal resection is not to be recommended, as the periosteum left obscures the subclavius muscle, and has to be immediately divided.

Lund had previously in 1879 carried out this step in its entirety.

2. Double ligature of the third part of the subclavian artery and vein, and division of the vessels between the ligatures.

3. The formation of two oval skin flaps, an antero-inferior and a postero-superior, and removal of the entire limb with the remaining external portion of the clavicle *en masse*.

The advantages of following this order in the performance of the amputation are—

1. No hæmorrhage from the axillary artery and its branches can take place.

2. Entrance of air into the large vein is guarded against, and oozing from the vessels of the neoplasm is minimised.

3. An almost bloodless section of the pectoral muscles and the cords of the brachial plexus is permitted, whilst division of the posterior muscles, where the arterial supply has not been cut off, is reserved for the last step of the operation.

4. The flaps are readily approximated, and while there are no spaces for the pocketing of discharges, the facilities for drainage are excellent.

5. It permits a free and wide division of the various structures, this being of special importance when a malignant growth has to be dealt with.

6. The resulting stump readily admits of the application of an apparatus to hide the deformity.

Accepting this method as a basis, in the case here recorded two points are mainly brought into prominence :

1. The shock to the patient.

2. The securing of the vessels.

1. *The shock*.—During the operation this was marked when the large cords of the brachial plexus were severed. On removal from the table the effects were speedily rallied from. The general shock was apparently much less severe than that which has been noted in cases where amputation at the hip-joint has been undertaken for malignant tumours

connected with the femur. This observation confirms the experience of Berger and Bennett May.

The table appended shows that shock *per se* is not much to be dreaded.

2. *Securing the vessels.*—If from the nature of the tumour there be free venous oozing on incising the superficial tissues, or if there be structural displacement from invasion by the growth, it would seem to be better, after resection of the clavicle, to proceed at once to the formation of the upper portion of the antero-inferior flap, division of the two pectoral muscles, and fully to expose the axillary artery and vein. These can then be readily traced up to the scalenus anticus muscle, and the subclavian artery and vein secured.

Both Berger and May have found that in proceeding to direct double ligature of the vessels, after removal of the clavicle, considerable care was necessary to secure the vein in two ligatures; this would be obviated by tracing it from below upwards.

In this case the first part of the axillary artery was tied and divided above the acromio-thoracic branch, yet on the seventeenth day there was secondary hæmorrhage, and dissection showed patency of the main vessel. A ligature placed higher failed to diminish the pulsation of the artery, whilst tying the subclavian behind the scalenus anticus proved successful.

This experience seems to point to primary ligature of the subclavian as offering the best security against secondary hæmorrhage, for by this means the arterial supply is arrested as far as possible from the edges of the flap and sources of irritation.

It should, however, be noted that in the cases operated upon by Syme and Southam (Nos. 5 and 44) the axillary vessels were tied without any complication resulting.

Statistics.—The number of cases tabulated, in which the entire upper extremity has been removed for neoplas-mata, is 43, and in one (No. 25) the operation was per-

formed for caries and osteo-myelitis, making a total of 44. For statistical purposes No. 28 may be excluded, as the operation not only consisted of removal of the scapula, but also of excision of the breast and portions of several ribs, thereby laying open the thoracic cavity.

From the immediate effects of the operation there were nine deaths. Of these, five were attributed to *shock*. Two (Nos. 9 and 24) succumbed the same day; two on the second day, No. 8 having fatty degeneration of several internal organs, and No. 18 having previously been a man of very intemperate habits; one (No. 41) died at the end of fifty-six hours, although the effects of the operation had apparently been recovered from.

Hæmorrhage caused two fatalities, No. 13 being due to loosening of the ligature securing the main vessels on the fifth day. No. 15 died the day after the operation.

Septicæmia (two), No. 7 on the fifth day; No. 17 on the sixth.

Fourteen cases *recovered* from the operation, to die at a later date with secondary deposits; one (No. 16) in three years; one (No. 12) in eighteen months; one (No. 32) in sixteen months; eleven (Nos. 1, 2, 19, 22, 30, 31, 35, 36, 37, 39, and 44) within the year.

One (No. 26) died of phthisis five months afterwards.

Ten cases may be counted as *cured*. No. 5 was living twenty-six years afterwards; No. 3, nine years; No. 21, six years; No. 20, five years. No. 23 lived three years, and death was not connected with the neoplasm. Nos. 6 and 11 were living two years after; Nos. 27, 42, eighteen months after. No. 25 was undertaken for caries from osteo-myelitis.

Uncertain, 10. For three (Nos. 14, 29, 38) no subsequent history is given; one (No. 40) was alive seventeen months after the operation; one (No. 43), thirteen months; two (Nos. 10, 34), twelve months; two (Nos. 4, 33) were living some months and three months respectively.

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Table of Cases.

Operator.	Sex and age.	Disease.	Date of operation.	Method.	Result.	Reference.	Remarks.
1 MacClellan	M. 17	Large encephaloid growth of shoulder	1838	Removal of arm, scapula, and greater part of clavicle	Healed; death 6 months after, with secondary deposits	Rogers, Amer. Journ. Med. Sci., 1868	—
2 Twitchell	—	Malignant growth	1838	—	Death in a few months from recurrence	New York Med. Journ., vol. viii, 1869	—
3 Mussey	Not given	Osteo-sarcoma	1845	Removal of scapula, arm, and external portion of clavicle	Healed; alive 9 years afterwards	Gross, System of Surgery, 1872	—
4 Whishaw	M. 8	Encephaloid growth of shoulder	1862	Removal of scapula, the outer third of clavicle, and the arm	Healed; alive some months afterwards	Lancet, vol. i, 1874, p. 819	—
5 Syme	M. 40	Fibro-chondroma of left humerus	May 7, 1863	Formation of semilunar flaps, clavicle divided at middle third; ligature of first part of axillary artery; removal of clavicle, scapula, and arm	Healed; alive in 1889	Monograph, Excision of Scapula, 1864. Communication from Mr. Annandale, present at operation (Nov., 1889)	Head of humerus resected Sept. 16, 1862. Tumour, size of walnut, removed from under cicatrix, Jan., 1863.

Operator.	Sex and age.	Disease.	Date of operation.	Method.	Result.	Reference.	Remarks.
6 Fergusson, Sir Wm.	F. 19	Spindle-celled sarcoma of right scapula	Nov. 11, 1865	Clavicle divided just external to sterno-mastoid muscle; subclavian artery compressed against rib; removal of clavicle, scapula, and arm by semilunar flaps. Hæmorrhage slight	Healed by end of December; alive, and exhibited at King's College, Oct. 19, 1867	Med. Times and Gaz., Nov. 25, 1865	Infra-spinous portion of scapula removed with attached tumour, Jan. 14, 1865; recurrence in June.
7 Thiersch	M. 25	Enchondroma of left shoulder	Sept. 2, 1869	Disarticulation at shoulder-joint; clavicle, acromion process, and glenoid sawn off, and remainder of scapula removed	Death in 5 days, with symptoms of lung œdema	Adelmann, Archiv für klin. Chirurgie, Bd. xxxvii, 1888	Tumour previously removed in 1866. P.M.—Sero-purulent exudation in pleural cavity; enchondromatous masses round pulmonary vessels.
8 Fergusson, Sir Wm.	M. 40	Osteo-sarcoma, involving left scapula and shoulder-joint, 2 years' growth	Oct. 19, 1867	Clavicle divided at outer third; subclavian compressed; clavicle, scapula, and arm removed, vessels and nerves cut last. 6 oz. of blood lost	Death, Oct. 21, 1867	Lancet, Nov. 2, 1867	P.M.—Fatty degeneration of internal organs.
9 M'Leod, Kenneth	M. 2	Sarcoma (mixed-celled) extending from right elbow to infra-spinous fossa	June 30, 1869	Formation of flaps; ligation of axillary artery and vein under pectoral muscle; removal of part of clavicle, the scapula, and arm	Died same day	Edin. Med. Journ., Dec., 1869	Tumour, said to be congenital.
10 Hamilton	M.	Colloid tumour of scapula, 6 years' growth	Dec. 12, 1870	Digital compression of subclavian; large anterior flap; removal of scapula and arm	Healed by Feb., 1871	New York Med. Record, 1871-2	Excision of tumour in 1865; recurrence and removal in 1868; attempted removal in 1869 frustrated by hæmorrhage.

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No.	Operator.	Sex and age.	Disease.	Date of operation.	Method.	Result.	Reference.	Remarks.
17	McGill	F. 58	Sarcoma, attached to axillary border and lower portion of right scapula	May, 1880	Formation of flaps; division of outer third of clavicle; ligature of subclavian artery and vein; removal of detached clavicle, scapula, and arm	Died on the 6th day	Brit. Med. Journ., Oct. 30, 1880	Flaps sloughed; death due to septicæmia.
18	Whitehead, Walter	M. 24	Sarcoma of right humerus, involving shoulder-joint, 8 months' growth	Jan. 26, 1881	Removal of outer third of clavicle; ligature of first part of axillary artery and vein; skin flaps formed; scapula and arm removed	Death, Jan. 27, 1881	Communicated by Mr. Whitehead, Nov., 1889	Patient was a barman, and very intemperate.
19	Després	M. 22	Recurrent osteo-sarcoma, involving scapula, skin, and axillary glands	June 19, 1882	Ligature of subclavian artery; formation of flaps; division of outer third of clavicle, and removal of it, with scapula and arm (entrance of air into subclavian vein)	Healed in 2 months; death in 7 months, with secondary lung deposits	Langenhagen (quoted at No. 12)	Six months before, part of infra-spinous fossa had been removed with primary growth.
20	Berger, Paul	M. 27	Osteo-chondroma of right arm and shoulder	Oct. 28, 1882	Resection of middle third of clavicle; double ligature of subclavian artery and vein (third part); removal of outer third of clavicle, scapula, and arm	Healed in 4 months	Monograph, L'amputation du Membre Supérieur dans la contiguïté du Tronc, Paris, 1887	Right forearm amputated for tumour on dorsum of right hand when 12 years old.
21	Heath, Christopher	M. 16	Sarcoma (spindle-celled, ossifying) of upper end of right humerus implicating scapula	July 4, 1883	Disarticulation of shoulder; scapula and outer third of clavicle removed separately	Healed in 59 days; alive in 1889	Lancet, March 1, 1884 (communication from Mr. Heath, Nov., 1889)	Recurrence in February (7th month) in cicatrix; removed. Second recurrence in 35 months; removed.

23	Vernueil	M. 23	Sarcoma (round-celled) of upper end of right humerus, implicating scapula and muscles	Nov. 2, 1883	Division of the middle third of clavicle. Double ligature of subclavian artery and vein, with division; acromion sawn through at level of cla- vicle and the arm re- moved; then the re- mainder of scapula taken away; 7 oz. of blood lost	Left hospital on 17th day with wound, superficial	L'Union Médicale, Jan. 1, 1884	Recurrence of disease in dorsal vertebrae in May, 1884 (Berger).
23	Watson, P. Heron	M. 33	Enchondroma of right humerus, 18 months' growth	Dec. 17, 1883	Formation of oval skin flaps; division of clavicle at middle third, and ligature of subclavian vessels; removal of sca- pula, arm, and outer third of clavicle	Healed; died 3 years after; exact cause of death not ascertained	Edin. Med. Journ., Feb., 1884 (commu- nication from Dr. Watson MacGillivray, Nov., 1889)	Enchondromata of fin- gers of both hands from early life; right middle finger ampu- tated by Syme.
24	McLeod, Kenneth	M. 20	Sarcoma (mixed- celled) of right humerus, 3 months' growth	July 28, 1883	Removal of portion of clavicle, scapula, and arm	Death same day (shock)	Indian Med. Gaz., Jan., 1884	P.M.—Recent infarcts in both lungs.
25	Béranger- Féraud	M. 23	Caries of left scapula; osteo- myelitis of humerus; destruction of shoulder-joint	May 20, 1884	Digital compression of vessels; subperiosteal re- section of scapula; re- moval of arm; clavicle not interfered with	Healed entirely, Jan. 22, 1885	Bull. de Thérap., Nos. 11 and 12, 1885	—
26	Czerny	M. 41	Sarcoma (spindle-celled)	July, 1884	Removal of clavicle, sca- pula, and arm	Healed in 24 days; death in Dec., 1884, due to pneumonia and laryngeal phthisis	Adelmann, Archiv für klin. Chir., Bd. xxxvii, 1888	Tumour previously re- moved in Dec., 1885.

Operator.	Sex and age.	Disease.	Date of operation.	Method.	Result.	Reference.	Remarks.
27 Ollier	M. 50	Myxo-sarcoma, originating in right scapula, implicating the soft parts round the shoulder-joint	Oct. 29, 1884	Subperiosteal resection of middle third of clavicle; double ligature and division of subclavian vein and artery; removal of outer portion of clavicle with scapula and arm	Left hospital Dec. 4, 1884; alive in April, 1886 (Berger)	Lyon Méd., Feb. 1, 1885	The silk ligatures applied to vessels separated in May, 1885 (Berger).
28 Domenico, Morisani	F. 54	Carcinoma of right breast, thoracic wall, axillary lymphatics, and surrounding tissues; 16 or 17 years' growth	Mar. 15, 1885	Removal of clavicle at junction of middle and internal thirds; ligature of subclavian artery and vein; removal of scapula, arm, neoplasm, and surrounding soft parts, together with several inches of the second, third, and fourth ribs; right thoracic cavity opened	Death from shock five hours afterwards	Il Morgagni. Agosto, Ottobre, 1885 (quoted by Berger)	—
29 Bergmann	M. 28	Sarcoma (periosteal) of right humerus and scapula; a year's duration	Mar. 23, 1885	Primary ligature of subclavian artery and vein; removal of scapula and arm	Healed in 7 weeks	Bramsfield, Ueber enige Fälle von Schulterblatt Extirpat., Berlin, 1888	—
30 Bell, Joseph	M. 30	Sarcoma (round-celled) of scapula involving humerus	May, 1885	Removal of portion of clavicle, scapula, and arm; hemorrhage restrained by "skewer" passed under clavicle and vessel and rubber band tied round	Healed; recurrence; death in a year	Manual of Surg. Operations, 6th edit. (communication from Dr. Bell, May, 1890)	—
31 Maling,	M.	Sarcoma (mixed)	Jan. 23,	Ligature of third part of	Healed by	Brit. Med.	—

No.	Operator.	Sex and age.	Disease.	Date of operation.	Method.	Result.	Reference.	Remarks.
37	May, Bennett	F. 21	Sarcoma (mixed-celled, ossifying in places) growing from upper end of right humerus; 2 years' growth	June, 1887	Subperiosteal resection of middle third of clavicle; double ligature of subclavian artery and vein; removal of scapula, outer third of clavicle, arm, and infiltrated supra-clavicular glands	Healed in 3 weeks; rapid recurrence in cervical glands; death	Ann. of Surg., December, 1888	—
38	Bergmann	F. 34	Sarcoma of left humerus	Jan. 24, 1888	Ligature of subclavian artery and vein; removal of part of clavicle, scapula, and arm	Healed	Archiv für klin. Chirurg., Bd. xxxvii, 1888	—
39	May, Bennett	M. 17	Sarcoma (round-celled) growing from periosteum of upper end of right humerus	April, 1888	Subperiosteal resection of middle third of clavicle; double ligature of subclavian artery and vein; removal of scapula, outer third of clavicle, and arm	Healed in 1 mo.; recurrence; death within a year	Ann. of Surg., Dec., 1888	—
40	Parkes, C. T.	M. 18	Sarcoma (round-celled) of humerus, involving shoulder-joint	Dec. 11, 1888	Ligature of subclavian artery; removal of scapula and arm	Healed in 6 weeks; alive in May, 1890	Journ. Amer. Med. Assoc., Mar. 2, 1889 (communication from Dr. Parkes, May, 1890) Ditto	—
41	Parkes, C. T.	M. 37	Sarcoma (round-celled) of head of humerus, involving shoulder-joint	Jan. 8, 1889	Resection of middle third of clavicle; double ligature of subclavian artery and vein; removal of scapula, outer third of clavicle, and arm	Death in 56 hours from shock	Exploratory incision into tumour made in Dec., 1888.	—

42	Chavasse	M. 40	Osteo- chondroma of right humerus, 10 years' growth	Jan. 21, 1889	Subperiosteal resection of middle third of clavicle; double ligature of first part of axillary artery and vein; removal of scapula, outer third of clavicle, and arm	Healed; alive in June, 1890	Profuse secondary hæ- morrhage on 17th day; ligature of second part of subclavian artery.
43	Lewis, E. A.	M. 47	Sarcoma (mye- loid ossifying) of head of left humerus	April 29, 1889	Ligature of subclavian artery; removal of sca- pula with half of clavicle and arm	Healed; no recurrence at date of publication	Annals of Surgery, Feb., 1890
44	Southam	F. 11	Sarcoma (round-celled) originating in subspinous fossa, involving axilla, and reaching as high as clavicle	Aug. 25, 1889	Formation and reflection of oval flaps; resection of outer half of clavicle; ligature of first part of axillary artery; removal of scapula, outer half of clavicle, and arm	Healed; left hospital Oct. 4; death in Jan., 1889, from recurrence	Brit. Med. Journ., Dec. 14, 1889 (commu- nication from Mr. Southam, June, 1890)

(For report of the discussion on this paper, see 'Proceedings of the Royal Medical and Chirurgical Society,' Third Series, vol. ii, p. 48.)

DESCRIPTION OF PLATE II.

Successful Removal of the Entire Upper Extremity for Osteochondroma (THOMAS F. CHAVASSE, M.D., C.M.Edin.).

FIG. 1.—Half-length portrait of subject, showing tumour growing from right humerus.

FIG. 2.—Half-length portrait, showing subject after recovery.

Fig. 1.

Fig. 2.

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