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ON RECURRENT DISLOCATION OF THE
SHOULDER - JOINT

*A contribution to its pathomechanics and the results of
Eden/Hybbinette's bone-block operation.*

BY

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Detachment of the glenoid labrum from the anterior margin of the glenoid had already by the end of the 19th century been recognised as one of the changes encountered in cases of recurrent dislocation of the shoulder. *Perthes* (1906) seems to have been the first to consider this articular lesion as a causative factor of redislocation in some cases and he even described an adequate operative method of treatment. In other cases he attributed the recurrence to a rupture of the supraspinatus tendon. It was *Perthes'* opinion that the choice of the operative treatment should depend on the particular lesion involved. *Lexer* (1936) held identical views. *Pettersson's* arthrographic examinations (1942), however, disclosed that of 31 cases with recurrent dislocation of the shoulder only 4 displayed rupture of the supraspinatus tendon. In these 4 cases the average age was considerably higher than the average age of the complete series, which suggests that the rupture rather may have been attributable to senile degenerative changes involving the tendon. Therefore the thesis that rupture of the supraspinatus tendon is a causative factor in redislocation finds no substantiation.

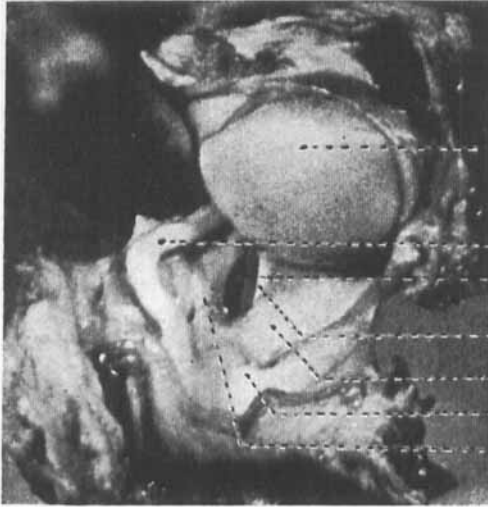
Earlier a typical alteration had been observed, consisting of a greater or lesser defect in the latero-posterior portion

of the head of the humerus. *Grégoire* (1913) and *Bazy* (1918) considered this deficiency as a congenital deformity predisposing to dislocation. *Hermodsson* (1934) examined a certain number of cases from the roentgenological point of view, some in the condition of primary dislocation, others later on. He states in conclusion that the so-called typical defect is to be regarded as a sequel of a compression fracture. In point of fact, however, the defect can be found even in cases of traumatic dislocation without a tendency to recurrence and *Hermodsson* therefore denies the lesion as a potent causative factor in redislocation.

The same author further points out that the average age in cases of recurrent dislocation is 29 years, as opposed to cases of traumatic dislocation without recurrence, where it is 53 years. *Pettersson* obtains identical results—29 and 51 years respectively. To explain these findings *Hermodsson* takes the following possibilities into account: in younger people the articular changes leading to recurrence are attributable either to the initial trauma or to congenital deformities, or changes acquired in childhood. Anglo-Saxon authors (*Bankart, Watson-Jones* etc.) are of the opinion that the avulsed glenoid labrum constitutes the predisposing factor, and point to the fact that such a detachment may follow injuries characteristically sustained in certain sports e.g. rugby. As a matter of fact, sports are being practised almost exclusively by younger people, and it thus appears reasonable that these age-groups should be particularly exposed to the risk of recurrent dislocation of the shoulder-joint.

The theory finds further substantiation in the post-mortem experiments described by other investigators, especially *Nicola*. The latter verifies that pure abduction strain produces rupture of the capsule attachment, while a blow in the longitudinal direction of the humeral shaft sustained by the abducted arm results in a detachment of the labrum from the anterior margin of the glenoid.

There is another possible mechanism for producing labral



Head of humerus.

Biceps tendon.

Communication to the subscapularis bursa.

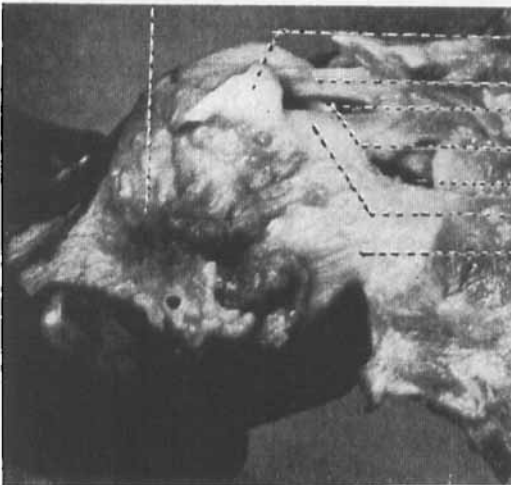
Top of the subscapularis tendon.

Inferior gleno-humeral lig.

Top of the glenoid cavity.

Middle gleno-humeral lig.

Head of humerus.



Subscapularis tendon.

Superior gleno-humeral lig.

Communication to the subscapularis bursa.

Biceps tendon.

Detached labrum.

Middle gleno-humeral lig.

Inferior gleno-humeral lig.

Fig. I.

Post-mortem specimen of a shoulder-joint showing the gleno-humeral ligament.

a. View from inside the joint.

b. Anterior view.

detachment from the anterior rim of the glenoid, as will appear from the following experiment.

In 3 cases I experimented with shoulder-joints from cadavers. The shoulder-joint was removed, consisting of the adjacent portions of the scapula and the humerus. The muscles were removed, leaving only capsule and ligaments. By means of a vice fixation of the humeral shaft was obtained. The scapula was so adjusted as to secure abduction and external rotation of the humerus. Thereupon the scapula was manipulated so as to correspond to a movement of extension of the abducted arm. In 2 cases there was a detachment of the labrum from the anterior margin of the glenoid, accompanied by a thin, fragmented osseous layer. In the third case there was a concentric rupture of the labrum whereby the innermost labral portion remained attached to the glenoid margin. Due to the lever effect of the greater tuberosity bearing upon the posterior glenoid margin this damage could be obtained without any larger effort. It is of interest, that the aperture thus made, limited anteriorly by the labrum and posteriorly by the glenoid margin, was not large enough to permit complete dislocation. I then replaced the same specimen in the original position, and accomplished a pure movement of abduction. Thereby the humeral shaft was pressed against the front of the edge of the acromion, the latter serving as a fulcrum. The articular capsule was now torn from its insertion on the medial aspect of the humerus in all 3 cases, and the head dislocated downwards and out of the articular cavity.

By the latter experiment I was able to confirm the finding stressed by *Nicola*, namely, that a pure abduction strain with the acromion as fulcrum will cause a typical rupture of the capsule by shearing off its fibres of insertion from the humerus. The conditions for spontaneous healing are good and redislocation does not take place. Traumatic extension, such as *Nicola's* traumatic concussion, on the other hand produces detachment of the fibrocartilaginous glenoid labrum. The labrum has, as all cartilage, only a very slight tendency

to heal, i.e. to become re-attached to the bone, and favourable conditions for redislocation are present (*Bankart & other authors*).

It may also be gathered from the above experiment that mere detachment of the glenoid labrum does not render possible a complete dislocation. There must be in addition an anterior capsular rupture, and in fact *Hybinette* observed at operation such a deficiency in the shape of a "Gothic arch"

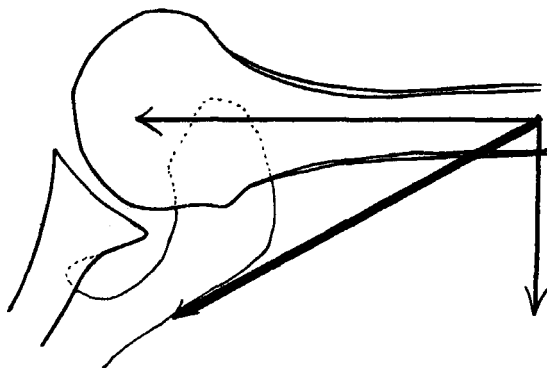


Fig. II.

Direction of the pull of the posterior fibres of the deltoid.

in several of his own cases. It should be emphasized in this connection, that this aperture is partly formed by the constant communication between the joint and the subscapular bursa, through which the top of the subscapularis tendon passes freely. The inferior border of the aperture is formed by the middle gleno-humeral ligament. If the latter is torn off the glenoid rim, or if the labrum is ruptured and simultaneously the aperture enlarged, capsular rupture takes place permitting complete dislocation of the humeral head in front of the neck of the scapula, i.e. into the subscapularis bursa. *Palmer* did not discover any rupture in cases operated upon by himself, and it is his opinion that the condition is only one of subluxation.

Reports on capsular laxity as the predisposing factor are

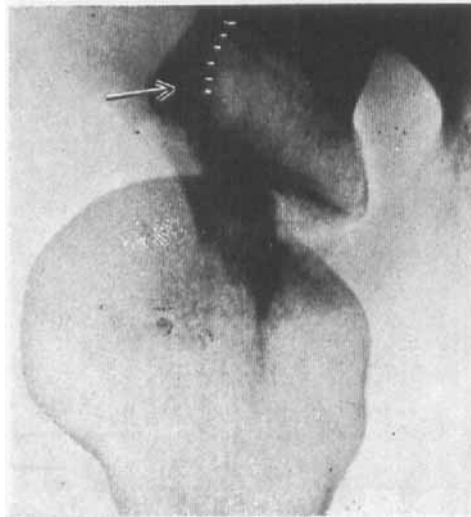


Fig. III a. Case No. 16. Operation 1939. Reexamination 1945.

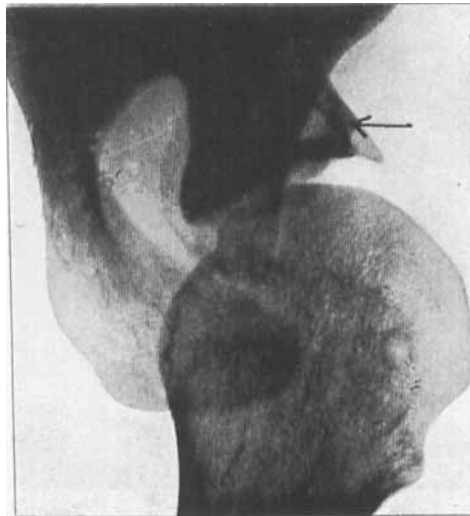


Fig. III b. Case No. 34. Operation 1942. Reexamination 1946.

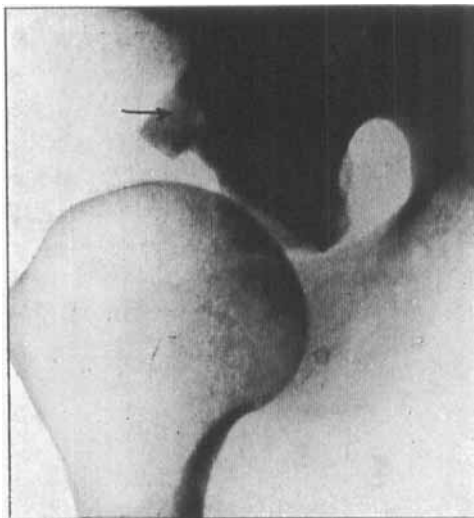


Fig. III c. Case No. 31. Operation 1943. Reexamination 1945.

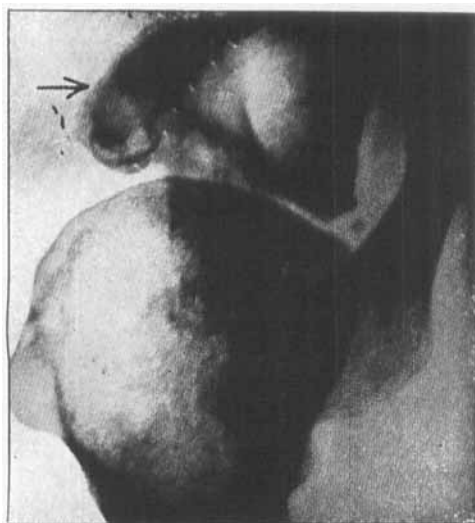


Fig. III d. Case No. 3. Operation 1936. Reexamination 1945.
Axial projection of the shoulder-joint operated upon according to Eden-Hybbinette's procedure. Bone-graft fused to the anterior margin of the glenoid (see →).

especially recorded in older medical literature. No definite significance can, however, be attached to the finding, as it is very difficult to establish with certainty a distension of an articular capsule which normally appears rather loose.

Of the above lesions of the shoulder-joint the detachment of the glenoid labrum is therefore the only pathological process left for discussion, and the majority of authors now hold the opinion that this is the cause of recurrent dislocation. The mechanism by which the labral detachment gives rise to redislocation has not, however, been clearly explained. The simple fact that this lesion often occurs in conditions of recurrent dislocation of the shoulder—always according to *Bankart*—does not provide any conclusive evidence. Lesions of the labrum may follow repeated subluxations or dislocations, without necessarily being the cause of them. Nevertheless, there are several factors in favour of the belief that the labral lesion is in the majority of cases the fundamental cause of redislocation.

To obtain a closer understanding one must first be clear on the forces which maintain the humeral head in the articular cavity. The atmospheric pressure plays in the first instance an important part in preventing separation between the glenoid and the head of the humerus (*Fick*). However, when sliding displacements in the shallow articular cavity take place, the soft tissue around the joint can be easily sucked in. It is then easy to imagine that the glenoid labrum acts as a sealing ring. In cases in which the anterior portion of this ring is either torn or detached, the soft tissues may follow the sliding backward of the humeral head, and thus be sucked in. Damage located in the anterior portion of the glenoid labrum would by this reasoning, lead to a backward dislocation, and such in fact does not occur. There is therefore no reason to suppose that the labral lesion leads to the abolition of the vacuum effect. *Bost, Inman, Palmer* and others believe that vacuum effect is eliminated when the posterior defect rotates over the glenoid. However, this does not explain redis-

location resulting from internal rotation and simultaneous extension, e.g. when the patient is putting on a coat. In this movement the posterior defect rotates outwards, away from the glenoid.

The muscles certainly act as a powerful stabilizing factor provided that they work coordinately. Hasty, violent or unexpected movements of the upper extremity eliminate this co-

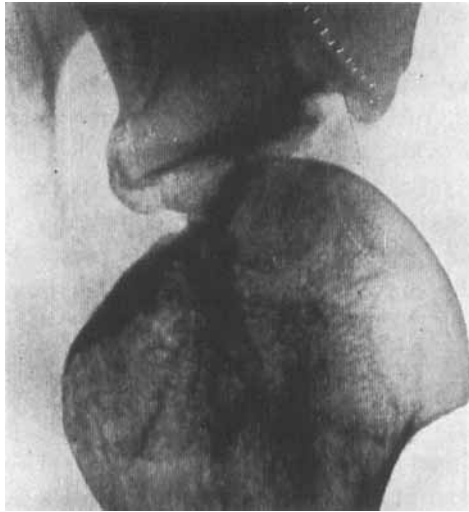


Fig. IV.

Case of spontaneous healing with new bone-formation at the anterior margin of the glenoid. Hosp. No. 31646.

ordination, so that the stability of the joint now depends on the capsule and the ligaments.

The ligaments of the joint are localized on its frontal aspect (Fig. I). Of these the coraco-humeral ligament and the superior gleno-humeral ligament prevent, the arm being pendant, the humeral head from sliding downwards. The middle and the inferior gleno-humeral ligament prevent sliding forwards in external rotation and in extension of the arm. The 3 last-named ligaments are intimately attached to the

glenoid labrum and a detachment of the labrum has therefore the same significance as an avulsion of the ligamentous attachments.

Redislocation of the shoulder characteristically occurs on certain normal movements of the shoulder-joint. These movements must be of such a kind as to produce a sliding forward of the humeral head in the glenoid. According to *Fick* the sliding takes place on supination of the pendant arm, but does not occur on supination of the abducted arm. This statement is debatable, but as it has no closer connection to the subject, a detailed discussion does not seem justifiable. On a further phase of motion, i.e. on extension of the arm, the humeral head ought to slide forwards. Extension is for the most part performed by the posterior portion of the deltoid muscle. The articular surface of the head being situated on the opposite side of the axis of rotation, glides forwards and is pressed against the anterior capsular wall. Also the force directed to the arm in the longitudinal direction of the humerus increases this pressure (Fig. II). By this movement the gleno-humeral ligaments are stretched and therefore give the stability of the joint. If the ligaments are detached, the head can slide forward. The mechanism of production is satisfactorily explained, if, in addition, there is a capsular rupture large enough to permit complete dislocation of the head of the humerus.

On the other hand there are many cases in which there is only subluxation, often reducible by the patient himself. As already mentioned the humeral head may be able to slide over the glenoid margin, but under normal circumstances there is no chance of the smooth and rounded humeral head becoming caught on the glenoid labrum, the fibres of which for the most part directly pass into the articular capsule. In cases with recurrent dislocation of the shoulder there is always (*Hermodsson*) evidence of a larger or smaller defect in the articular surface of the humeral head which is denuded of cartilage. The ligamentous avulsion liberates the anterior margin of the glenoid, and thus grants a more or less considerable prominent edge that will allow the head to be caught

on its margin (*Bazy, Grégoire*). Stress must therefore be laid upon the fact that it is not only the sliding forwards of the humeral head which constitutes subluxation, but that definite pathological conditions do not arise until the sliding backwards is prevented by the fixation of the head.

The theory of a primary ligamentous damage even explains the mechanism of dislocation in cases, where there is no detectable labral lesion seen at the operation. In these cases it is possible, that there is a lesion involving the ligamentous attachments on the humerus. *Nicola* found in 6 of a total 25 operated cases, evidence of a capsular lesion located to the attachment on the humerus.

The possible factors of importance in causing redislocation, are as follows:

1. Avulsion of the ligamentous attachments from the frontal rim of the glenoid, which in most cases manifests itself as a detachment of the glenoid labrum.
2. Posterior hollow or defect in the articular surface of the humeral head which permits the head to become caught in a position of subluxation.
3. Rupture of the capsule in the cases in which there is dislocation.

The operative treatment.

During this century the total number of operative methods suggested for the surgical treatment of recurrent dislocation of the shoulder has exceeded the number of years which have elapsed. Every year new procedures or variations of the older methods are published. This is certainly attributable to the fact that no ideal method has yet been found. If success is required in almost 100 per cent of cases, there are two ideal methods, namely, the *Eden-Hybbinette* and the *Bankart* operation. If consistently good results are required as well as a simple operative technique, then no ideal method has as yet been described. Those who are further interested in a critical analysis of the results of different operative methods should refer to *Anschütz'* and *Thomassen's* papers.

The best operations are, as it appears from a comparison of the material published, plastic procedures in the region of the anterior glenoid margin with bone-grafting according to *Eden-Hybbinette*, and reposition of the glenoid labrum in conformity with *Bankart*. The incidence of redislocation after *Eden-Hybbinette* operations is:

Thomasen's collection:	169 cases	—	1 recurrence
Hublin's collection:	31 cases	—	2 recurrences
total:	200 cases	—	3 recurrences = 1.5 %

Palmer has recently made a study of 60 cases with 4 recurrences. However, in contra-distinction to other authors, he took into account recurrences in cases in which there was redislocation after renewed injury.

Operation according to *Bankart*:

Bankart	27 cases	—	0 recurrence
Watson-Jones	52	„	— 1 „
Perthes	5	„	— 0 „
Stark	12	„	— 0 „
Bost	8	„	— 1 „
Crawford Adams	18	„	— 1 „
Eyre-Brook	12	„	— 0 „
total:	134 cases	—	3 recurrences = 2.2 per cent

Among the other surgical procedures more commonly employed the fixation of the long biceps tendon according to *Nicola* seems to be the operative procedure most usually performed. A comparison of the clinical material published reveals the following figures (modifications of the method being also counted):

Anschütz's material	89 cases	—	12 recurrences
Watson-Jones	18	„	— 5 „
Horwitz-Davidsson	20	„	— 3 „
Camitz	9	„	— 1 „
Crawford Adams	51	„	— 21 „
total:	187 cases	—	42 rec. = 22 per cent.

Nicola, who had earlier obtained favourable results (37 cases with 1 recurrence) recommends, in a paper (1942), complementing the operation by suture of the labrum according to *Bankart* in cases in which there is evidence of labral detachment.

Judging from the reports published in France, *Oudard's* method, which consists in lengthening the coracoid process, has been the only operation used in that country during these latter years. *Oudard* recorded favourable results, with 1 recurrence among 22 cases. Later on *Thomassen* published 9 cases in which there were 4 recurrences. Finally, *Cauchoix* (1945) reported in the *Actualités chirurgicales*, that the method is not the operation of choice, without, however, giving any figures.

As already mentioned there are several communications by various authors on the end results provided by the *Eden-Hybbinette* operation. Of the original authors of the method only one, namely, *Hybbinette*, has published a more detailed report on the functional condition of the shoulder-joint after operation. Different investigators have emphasized certain disadvantages of the method: it is technically difficult; there is risk of infection through the intraarticular manipulations; and above all, arthrosis deformans is likely to develop after the intra-articular bone-grafting.

I have made a follow-up examination of the series of cases of recurrent dislocation operated upon in the Orthopaedic Clinic of the Karolinska Institute. This follow-up study dealing with cases subjected to operation during the period autumn 1935 up to and including 1944, is of a certain interest.

The Eden-Hybbinette Operation.

43 operations were performed on 42 patients (one bilateral)

Duration of follow-up:	1 year	—	6 cases
	2-3 years	—	6 „
	4-10 „	—	31 „

The re-examinations have been carried out by myself in 38 cases, with roentgenological control in 37 cases. 2 were examined by other doctors in the country, one of them with x-ray in addition. 2 other patients residing abroad replied to a questionnaire. Finally, 1 had died 5 years after the operation from intercurrent disease: the patient's daughter filled in the questionnaire.

Clinical material:

Sex: 27 males, 15 females.

Average age at the primary dislocation: 22.7 years.

Number of dislocations before operation:

3 times — 4 cases
 4- 9 „ — 15 „
 10-100 „ — 31 „

Genesis of the initial dislocation:

traumatic — 38 cases
 spontaneous — 3 „
 no reason given — 2 „

Furthermore 27 patients stated that they were troubled in certain movements by a feeling of insecurity in the shoulder. I think this sensation of insecurity is due to the fact that the patient feels on certain movements an impending dislocation, which he, however, can prevent by stopping the movement. This sensation, obviously a sign of a marked degree of articular instability, was, however, not only found in conditions of frequently recurring dislocation, but also in 3 cases in which there was a history only of 3-4 recurrences. This feeling of insecurity can be such a source of trouble to the patient as to become a definite indication for operation.

Epilepsy as a cause of the original trauma was not stated by any patient.

In some cases the patient could give a more detailed account of the movements which led to recurrence.

External rotation of the arm pressed to the body 4 cases
 Extension with simultaneous internal rotation 5 cases

CASES OPERATED ACCORDING TO

Case No.	Hospital No.	Sex	Age at Primary Luxation	Cause	Date of Operation	State of Glenoid Labrum	Postoperative Complications	Duration of Observation
1a.	35346 right	♂	22 years	traumatic	1935	no specification	0	10 years
1b.	35346 left	♂	23 "	?	1941	detached	0	4 "
2.	234/36	♂	19 "	traumatic	1936	detached	0	9 "
3.	504/36	♀	24 "	spontaneous	1936	undamaged	mobilisation 2 months after op.	9 "
4.	2114/36	♀	14 "	traumatic	1936	detached	0	9 "
5.	2623/36	♂	46 "	traumatic	1936	no specification	pneumonia, empyema	9 "
6.	145/36	♀	18 "	traumatic	1936	torn and worn	pneumonia. mobilisation	9 "
7.	113/37	♀	27 "	traumatic	1937	detached	0	9 "
8.	1269/37	♀	15 "	traumatis	1937	torn and worn	0	8 "
9.	489/37	♀	31 ,	traumatic	1937	no specification	0	8 "
10.	33662	♂	34 "	traumatic	1937	no specification	0	5 "
11.	1833/37	♂	25 "	traumatic	1937	unreliable specification	0	8 "
12.	3081/38	♂	17 "	traumatic	1938	torn and worn	0	7 "
13.	3494/38	♂	23 "	traumatic	1938	absent	septic arthritis	7 "
14.	4656/39	♂	21 "	traumatic	1940	no specification	0	5 "

EDEN-HYBBINETTE'S OPERATION

Mobility		Roentgenographic Findings (axial projection)	Position of the Graft Relative to the glenoid rim	Arthrosis Deformans	The Patient's Observations	Change of occupation
Combined Abduction	External Rotation					
180°	10°	+	medial	0	0	0
160°	20°	+	projecting	0	0	0
180°	30°	+	level	0	0	0
140°	0°	+	projecting	+	sensation of draught in shoulder-joint	from dress-maker to shop-assistant
180°	45°	+	projecting	0	0	0
40°	0°	0	—	ankylosis	rigidity; no working-capacity on account of myocarditis	0
135°	0°	+	level	0	0	0
180°	45°	+	level	0	0	0
180°	30°	+	level	0	pain when shaking carpets	0
180°	45°	+	level	0	0	0
—	—	0	—	—	according to letter from daughter: full range of motion, no discomfort.	died 1942
175°	60°	+	not visible	+	0	0
160° 120° prior to operat.	45°	+	projecting	0	0	0
45°	0	0	—	ankylosis	rigidity	0
180°	45°	+	projecting	0	0	0

Case No.	Hospital No.	Sex	Age at Primary Luxation	Cause	Date of Operation	State of Glenoid Labrum	Postoperative complications	Duration of Observation
15.	493/39	♂	20 years	traumatic	1939	detached	0	7 years
16.	2415/39	♂	22 ..	?	1939	detached	0	6 ..
17.	1993/39	♂	14 ..	traumatic	1939	detached	0	6 ..
18.	133/40	♀	18 ..	traumatic	1940	detached	0	5 ..
19.	906/40	♀	18 ..	traumatic	1940	detached	0	5 ..
20.	1755/40	♀	15 ..	traumatic	1940	detached	0	5 ..
21.	2024/40	♀	14 ..	traumatic	1940	absent	0	5 ..
22.	2118/40	♂	25 ..	traumatic	1940	»free«	0	5 ..
23.	3500/40	♂	28 ..	traumatic	1940	absent	0	5 ..
24.	248/41	♂	30 ..	traumatic	1941	torn and worn remnants	0	5 ..
25.	1457/41	♂	28 ..	traumatic	1941	absent	0	4 ..
26.	2307/41	♂	18 ..	traumatic	1941	detached	0	4 ..
27.	2647/41	♂	15 ..	traumatic	1941	absent	0	4 ..
28.	3663/41	♂	18 ..	traumatic	1941	absent	0	4 ..
29.	3475/41	♂	20 ..	traumatic	1941	insignificant remnants	0	5 ..
30.	2532/42	♀	42 ..	spontaneous	1942	insignificant remnants	0	3 ..
31.	5632/42	♀	25 ..	traumatic	1943	»damaged«	0	2 ..

Mobility		Roentgenographic Findings (axial projection)	Position of the Graft relative to the glenoid rim	Arthrosis Deformans	The Patient's Observations	Change of occupation
Combined Abduction	External Rotation					
180°	55°	+	level	0	0	0
175°	45°	+	level	0	0	0
175°	45°	+	level	0	0	0
180°	0	+	level	0	partial serratus paresis, easily fatigued	from store-house-employer to shop-assistant
180°	45°	+	level	0	0	from dress-maker to factory-hand
180°	0	+	slightly medial	0	0	0
180°	45°	+	level	0	0	0
180°	30°	+	level	0	0	0
180°	—	0	—	—	according to letter from surgeon: full range of motion, no discomfort.	0
180°	60°	+	level	0	0	0
180°	45°	+	level	0	0	from rough worker to mechanic
160°	45°	+	projecting	0	insignificant pain in hasty movements	0
180°	70°	+	level	0	0	0
180°	90°	+	level	0	0	0
180°	40°	0	—	—	0	0
170°	50°	+	projecting	0	0	0
180°	30°	+	projecting	0	slight pain in external rotation and extens.	0

Case No.	Hospital No.	Sex	Age at Primary Luxation	Cause	Date of Operation	State of Glenoid Labrum	Postoperative Complications	Duration of Observation
32.	3860/43	♂	25 years	traumatic	1943	Insufficiently developed	0	2 years
33.	4816/41	♀	25 "	traumatic	1942	absent	0	4 "
34.	4752/42	♂	18 "	traumatic	1942	partly detached	0	3 "
35.	6543/43	♂	19 "	traumatic	1944	detached	0	1 "
36.	6047/43	♂	19 "	traumatic	1943	detached	0	2 "
37.	2893/36	♀	20 "	traumatic	1944	detached	0	2 "
38.	1472/44	♂	20 "	traumatic	1944	no specification	0	1 "
39.	4732/44	♂	32 "	traumatic	1945	detached	0	1 "
40.	5850/44	♀	19 "	spontaneous	1944	detached	0	1 "
41.	6707/44	♂	19 "	traumatic	1945	detached	0	1 "
42.	6500/44	♂	32 "	traumatic	1944	detached	0	1 "

Abduction, which incidently entails simultaneous extension, as the glenoid cavity normally faces antero-laterally 24 cases

In no patient did dislocation occur on mere flexion or flexion combined with internal rotation. But dislocation took place in one patient on flexion and simultaneous external rotation.

In actual fact there were many redislocations which occurred in hasty, unexpected movements, difficult to analyse, and possibly some of them were due to incoordinate muscular action.

Mobility		Roentgeno- graphic Findings (axial projection)	Position of the Graft relative to the glenoid rim	Arthrosis Deformans	The patient's Observations	Change of occupation
Combined Abduction	External Rotation					
180°	30°	+	projecting	0	0	0
180°	30°	+	projecting	0	0	0
180°	45°	+	level	0	0	0
180°	10°	+	projecting	+	0	0
—	—	0	—	—	according to letter: No discomfort, full range of motion	0
180°	45°	+	projecting	+	0	0
180°	40°	+	level	0	0	0
160°	45°	+	level	0	0	0
180°	45°	+	level	0	0	0
—	—	0	—	—	according to letter: No discomfort, full range of motion	0
180°	30°	+	projecting	+	0	0

The operations have been performed by 7 different surgeons and, in essence, the principles indicated by *Hybbinette* have been followed. As is known, the important points to observe are: extensive incision in the articular capsule by division of the subscapularis tendon near its insertion; fashioning a so-called subperiosteal pocket on the anterior aspect of the neck of the scapula, into which is inserted a quadrangular, and in transverse section, hook-like bone-graft (Fig. III d) removed from the iliac crest. The graft shall overlap the articular surface by $\frac{1}{2}$ -1 cm. Finally *Hybbinette* stressed the importance of overlapping the subscapularis tendon, when it is sutured. It could not be ascertained from

the operation notes in all cases, whether these principles recommended by *Hybbinette* had been followed. In 13 cases a hook-like bone-graft was employed. In 9 cases mention is made of the bone-graft being placed in such a position as to overlap the level of the articular surface, while the graft was placed on a level with the joint surface in 4 cases. In the majority of cases no overlapping of the subscapularis tendon was resorted to when tying the sutures.

A lesion of the labrum was observed in 34 cases. In one case the labrum was found to be intact, and in 8 cases the description of the labrum was either confused or entirely missing.

No capsular rupture as described by *Hybbinette* was recorded, but 2 cases exhibited an "anterior synovial pocket" (case No. 4) and an "anterior plum-like pocket" respectively (case No. 10).

In 1 case at operation, there was no evidence of a lesion of the glenoid labrum or of the capsule and it is important to note that in this case there was no history of trauma. This might have been a condition of congenital ligamentous aplasia or ligamentous laxity. Also there were 2 patients in whom, although they gave no history of trauma, there was typical labral detachment seen at operation. An injury sustained in childhood may possibly have been concerned in these cases. Hermodsson, however, states that the interval between the trauma and the first redislocation is 1 year at most in 75 per cent of cases, the longest interval is 7 years. I should therefore rather suggest ligamentous aplasia or laxity even in these cases. All these 3 cases were females. An interpretation of the cause of redislocation can not, however, be stated with certainty in these cases. There is thus a group of cases where the genesis is unknown.—In this connection there is another interesting case. The patient, a girl aged 15, sustained the primary dislocation while practising gymnastics, holding herself suspended on a bar by one arm. There was therefore quite a fair amount of strain upon the shoulder joint, but this cannot be described as a real trauma. At operation an

undamaged glenoid labrum was found, while the capsule was separated from the labrum by a deep pocket. This case being an example of ligamentous avulsion with intact glenoid labrum, does further substantiate the hypothesis that the avulsion of the insertions of the ligaments must be cited as the major causative factor of redislocation.

Results of operation.

No case of redislocation occurred.

The functional condition of the shoulder-joint in the patients' opinion:

37 cases are free from pain and have normal function.

3 cases record mild pain in certain movements: 1) on shaking carpets. 2) in violent abduction. 3) in external rotation and extension.

1 patient mentions slight tiredness with slight limitation of rotation (paresis of the serratus was noticed postoperatively).

2 patients were hampered on account of ankylosis of the shoulder.

The author's judgment of the result.

Excellent result in 31 cases with normal or very slightly restricted range of movement.

Good result in 9 cases with insignificant restriction of movement.

Satisfactory result in 1 case in which there was a paresis of the serratus, first noted after operation.

Unsatisfactory result in 2 cases with ankylosis. A more detailed account of the 2 cases just mentioned is given because one of the arguments against Hybbinette's procedure is the risk of osteo-arthritis and subsequent ankylosis.

Case No. 5 operated in 1936. Pleuro-pneumonia leading to an empyema developed postoperatively. This complication rendered mobilizing physiotherapy impossible and led to rigidity of the shoulder. The roentgenogram taken in 1946

showed ankylosis. In this case the complication most probably followed the anaesthetic.

Case No. 13 operated in 1938. Already prior to operation the patient showed evidence of infection in the upper respiratory tract. He was nevertheless subjected to operation. After the operation high fever and mental confusion supervened. As the condition did not improve, exploration of the wound was advised and carried out, but no certain infection was discovered. In spite of the negative finding, drainage of the wound was performed. Later on signs of infection did supervene, necessitating resection of the humeral head. In Prof. Waldenström's opinion there had been a condition of influenzal encephalitis inaccurately interpreted, the operative manipulations not being responsible for the failure. The patient was, however, only very slightly hampered by the restricted movement and his ability to practice sports, e.g. swimming and skiing was not seriously affected.

Mobility of the shoulder after operation:

a) Abduction (combined):

170-180 degrees	35 cases (3 according to letter)
160 " "	4 "
130-140 "	2 "
45 " (ankylosis)	2 "

b) External rotation with the dependent arm:

Normal range of motion = sound shoulder-joint	14 cases (3 according to letter)
$\frac{2}{3}$ of normal range of motion	20 cases
$\frac{1}{4}$ " " " " "	3 "
0 " " " " "	6 " (comprising 2 cases with ankylosis)

The total amount of rotation movement was practically normal in 35 cases, and diminished in 7 cases. In only 3 cases the patients were disturbed by the reduced amount of rotation movement. An employee was troubled by lack of external rota-

tion movement, when she tried to reach articles from the shelves behind her. The 2 other cases were the above-mentioned patients with ankylosis.

Roentgenographic findings.

On follow-up examination 37 cases were subjected to X-ray control. Through axial projection with the radiations directed to the axilla, and the film in epaulette-position on the shoulder, the anterior glenoid margin was visualised (Fig. III). Of the 36 cases examined in this manner, the bone-graft was disclosed in all but one. The incorporated graft had most often fused at the place at which it had been inserted at operation, and in one case in which two bone-grafts had been used, (because the first one had slipped down), both grafts had roentgenographically consolidated.

In 22 cases the grafts were placed at operation above the level of the articular surface, in conformity with *Eden's* and *Hybbinette's* instructions. Of these cases 13 consolidated in this position, while in 8 cases the bone-graft fused level with the joint surface. In one case consolidation took place 1 cm. below the glenoid margin. In 4 cases the bone-graft inserted on a level with the joint surface consolidated in the same place. From the above it may be concluded that the insertion of the bone-graft on a level with the glenoid margin is as effective as leaving the graft above the joint surface. In 2 cases the bone-graft fused below the joint surface. But in spite of the apparent mechanical failure, redislocation did not occur. It thus appears that the most important rôle assigned to the graft is to fasten the capsule and the ligaments to the glenoid margin. Therefore it seems to be unimportant to form a bony buttress or shelf, a small graft level with the joint surface being probably as effective as a large, prominent one.

Another important argument against *Eden-Hybbinette's* operation is that the bone-graft, occupying a partly intra-articular position, predisposes to the development of arthrosis deformans. The following table shows the relation between the

position of the bone-graft, the range of rotation movement and the incidence of postoperative arthrosis deformans.

	Total number of cases	Cases with arthrosis
1) Graft projecting beyond the glenoid rim, with considerable restriction of external rotation	3	2
Graft projecting beyond the glenoid rim, with good range of external rotation	10	1
2) Graft level with the glenoid rim, with considerable restriction of external rotation	2	0
Graft level with the glenoid rim, with full range of external rotation	18	0
3) Graft placed medial to the rim, with considerable restriction of external rotation	2	0

The table reveals that the position of the bone-graft does not influence the range of external rotation: the 7 cases with considerable restriction of external rotation are in same proportion referable to all 3 groups, and both cases assigned to group 3 suggest that other factors play a part. The time of fixation after operation was the same in these 2 patients as in the other cases, namely, 2-3 weeks, and the postoperative course was free from complications. Possibly, the restriction of external rotation was caused by shortening the subscapularis tendon, when tying the sutures, but there was no mention of this in the operative report.

The table further reveals that among 13 cases in which the bone-graft overlaps the glenoid margin, 3 displayed changes of arthrosis deformans, while of the remaining 22 cases with the graft not projecting beyond the glenoid rim, there was no arthrosis. Of the 3 cases with arthrosis 1 had been operated upon in 1936 (Fig. III d) and 2 in 1944.

Moreover a fourth case with postoperative arthrosis deformans was recorded, namely, the one in which the remnants of the graft failed to be discovered. Finally in a fifth case the changes of arthrosis deformans were of the same extent as prior to operation.

The material is insufficient to provide a reliable conclusion; it points however to the probability that a projecting bone-graft may predispose to arthrosis deformans.

In 28 cases the records or the patients themselves gave information as to the duration of postoperative working-incapacity:

1 month	8 cases
2 months	7 "
3 "	7 "
4 "	3 "
5 "	3 "

Complications.

In addition to the 2 above-mentioned cases in which there was ankylosis as a postoperative complication, a further case developed pneumonia after operation. In another case (No. 3) mobilisation of the shoulder-joint was resorted to under narcosis, 3 months after operation. On follow-up examination this patient showed a range of 140 degrees of abduction, and no outward rotation and roentgenological evidence of narrowing of the articular cartilage.

The operation did not cause any patient to change his occupation. 4 patients did not return to their former employments on account of other circumstances. 27 patients are practising sports of one kind or another. 6 of these record a certain cautiousness, due in 4 cases only to the apprehension of damaging the shoulder-joint again. The other 2 avoid suspension e.g. on bars, when taking gymnastic exercises, the first on account of slight pain, the other because of a feeling of a catch in the shoulder.

As already mentioned the operations were performed by

7 different surgeons, all of whom obtained equally satisfactory results. Somewhat less favourable results were obtained in the 13 first operations performed over the period 1936-1938: among those there are the 2 cases with ankylosis, and 2 cases in which mobilisation of the shoulder was decided after the operation.

The Nicola operation.

This operative method, incidentally described by Rupp, seems nowadays to be one of the most usually employed. There are various techniques which have been recommended for the fixation on the humerus of the biceps tendon. However, the principle of securing a solid fixation of the humeral head has been the basis of all techniques. An exception was *Rupp* himself who aimed at preventing the biceps tendon from pressing down the humeral head.

During the interval 1942-1944, 8 patients underwent at our Clinic the *Nicola* operation. These patients have also been followed up, and a comparative analysis of these cases is interesting.

Of the patients 5 were men and 3 women. In all cases there was history of injury. The average age at primary dislocation was 30 years. Duration of follow-up was 1½ years in 1 case, 2 years in 3 cases and 3 years in 3 cases. 1 patient was re-operated upon using *Eden-Hybbinette's* operation within 2 months of first operation. The follow-up examination was carried out by myself in the remaining 7 cases.

In 3 cases redislocation took place after operation.

Case 1) Hosp. No. 3035/41. Woman aged 64. Recurrence immediately after operation. It could be established on palpation that the labrum was torn off the anterior margin of the glenoid and in fact the margin itself was entirely missing. Redislocation ensued immediately upon operation, and on follow-up examination the head of the humerus was found to have slipped forwards. This case reveals that the *Nicola* operation fails in more severe cases in which arthrotomy must be designed to explore the extent of articular damage.

Case 2) Hosp. No. 679/43. Man, aged 36. Spontaneous re-dislocation 11 months after operation, and in the following 2 years, 4 further recurrences took place. At the follow-up examination the patient complained of pain when moving the shoulder-joint. He also displayed quite a marked weakness in flexion of the elbow, and the long biceps tendon was not recognizable on palpation. Obviously, the biceps tendon had failed to heal; perhaps there even was a secondary rupture of the tendon.

Case 3) Hosp. No. 6047/43. Redislocation followed immediately after operation, during the postoperative restlessness. Reoperation according to *Eden-Hybbinette's* procedure 2 months later.

If the last case be said to have sustained a new trauma, then the method is not responsible for the failure. Then, of 7 operations performed, 2 gave rise to recurrences.

As to the remaining 5 cases the result was satisfactory to the patients: in 2 cases there was a slight limitation of rotation movement and, also, insignificant aching pain on movements in one of the cases. Objective examination revealed good range of movement in the shoulder in 3 cases. There was restricted mobility in 2 cases, one of them with a range of 150 degrees in abduction and half of the normal range of external rotation, the other having regained a range of 120 degrees abduction, while the range of external rotation was 0 degree.

Despite the objection that the *Nicola* operation can hardly be judged as reliable, this method may certainly be employed, as indeed *Watson-Jones* points out, in patients who lead a sedentary life.

As already pointed out, redislocation usually occurs on outward rotation and extension. An operative procedure which provides a check to these movements is *Matti's* transplantation of the subscapularis insertion to the greater tuberosity. *Matti* gives an account of 15 cases without any recurrence, 8 of whom have been followed up 3—21 years. Certainly this method is worth a trial. Another interesting operation is

Gallie's fascial repair of the ligaments. His recurrence rate is 7 in 175 operations performed. However, his method seems to be a difficult procedure from the technical point of view.

Prognosis in cases not subjected to operation.

When discussing the advantages provided by the different operative procedures, one is often impressed by a relatively high percentage of cases which heal irrespective of the method employed. Even procedures with directly opposite effects, such as shortening the subscapularis tendon according to *Matti*, or tenotomy of the same tendon according to *Bülów-Hansen*, are successful, and *Mandl* even obtained definite cure by auto-hæmotherapy directed to the front of the capsule in 2 cases out of 3. Explanation of these remarkable results might be attributed to the fact that the operation performed leads to a certain restriction of the range of movement in the shoulder, so that there is no longer any possibility of getting the favourable position for redislocation. Another possibility is spontaneous healing of the labral detachment. It would therefore be of interest to see the clinical features and evolution in patients who were not treated by any operation. I could discover only a single study made on this subject, namely *Anschütz's* contribution reporting on 10 cases. In 2 of these there was spontaneous recovery. The duration of follow-up had been 4 and 9 years respectively.

I observed myself 13 patients who had displayed positive evidence of dislocation according to past history records. Operation was advised in all cases, but the patients either declined or postponed operation for various reasons. 6 patients were examined by myself, while the remaining 7 replied to the questionnaire. 6 patients consider themselves definitely cured.

Case 1) H.No. 1784/37, born 1898. Teacher. Traumatic origin, with 5 redislocations and several sublaxations. Primary dislocation 1916, last recurrence 1937. Does not display any cautiousness. Follow-up 10 years.

Case 2) H.No. 31646, born 1907. Packing-ware-house em-

ployee. Traumatic origin. 2 recurrences and several subluxations. Primary dislocation 1931, last 1942. Follow-up radiographs (Fig. IV) revealed a bone formation located in the front of the neck of the scapula, overlapping the level of the joint surface, and giving the same appearance as an incorporated bone-graft. Probably, the recurring dislocations stimulated new bone growth, and thus achieved healing in conformity to *Eden-Hybbinette's* principles. The patient does not display any caution in movements. Follow-up 3 years.

Case 3) 2195/42, born 1918. Military officer. Traumatic origin. 6 recurrences. Primary dislocation 1936, last 1944. Avoids certain movements. Follow-up 2 years.

Case 4) 1423/46, born 1910. Journalist. Traumatic origin. Primary dislocation 1938, last recurrence 1944. Displays a certain caution in movements. Follow-up 2 years.

Case 5) 31274, born 1921. Origin not specified. Several recurrences. Replied to questionnaire. Primary dislocation not recorded, last recurrence 1938. Displays no caution in movements. Follow-up 7 years.

Case 6) 492/39, born 1914. Sawmill-worker. Origin not specified. Answered questionnaire. 2 recurrences. Primary dislocation 1936, last 1941. Follow-up 5 years.

In conclusion there was positive evidence of spontaneous healing in 3 cases (Nos. 1, 2 and 5) and probably even in a fourth case (No. 6) in which however no mention was made of the patient's confidence in his shoulder. In 2 cases (Nos. 3 and 4) the patients concerned display a certain cautiousness. Therefore no reliable conclusion can be reached as to whether a spontaneous healing did take place. 3 further cases stated their condition to so large an extent improved, that redislocations did not occur readily.

Grading the above-mentioned 6 cases as mild cases with a smaller number of recurrences in the past history is justified. As a matter of fact, these patients did not even complain of a feeling of insecurity in the shoulder-joint. Even so, the study of these cases leads to the definite observation that spon-

taneous recovery is possible. It even appears from case No. 2 how the condition may heal, namely, by new bone formation.

S U M M A R Y

- A. The changes in the shoulder-joint which may cause dislocation or subluxation in normal movements are as follows:
1. Avulsion of the gleno-humeral ligaments from the anterior glenoid margin, which in the majority of cases appears at operation as a detachment of the glenoid labrum. Thereby the anterior support disappears, which prevents the head of the humerus from sliding forwards on outward rotation, and on extension.
 2. Posterior defect in the humeral head which makes it possible for the head to be caught on the anterior glenoid rim. If this condition is fulfilled, an intra-capsular subluxation may arise.
 3. Rupture of the capsule according to *Hybbinette's* description in more advanced conditions of recurrent dislocation.
- B. The follow-up examination of 42 patients with 43 shoulder-joints operated upon according to *Eden-Hybbinette's* method discloses:
1. No recurrence.
 2. The bone-grafts were found to have soundly fused in 35 of 36 cases with roentgenographic control.
 3. It is recommended to insert the bone-graft level with the glenoid rim and not overlapping it. By this measure one is likely to avoid arthrosis deformans.
 4. It appears that the bone-graft should probably not be designed to build out the glenoid margin. It is wiser to regard the graft as a method of connecting the capsule and ligaments to the glenoid margin.
- C. The follow-up examination of 8 cases having undergone the *Nicola* operation reveals:
1. 3 recurrences (one of traumatic origin).

2. One of the cases illustrates the inadequacy of the method and the necessity of performing an arthrotomy in order to establish the extent of the articular damage.
- D. The follow-up review of the 13 cases not subjected to any operation shows that ascertained spontaneous healing took place in 3 cases.

RESUME

- A. Les altérations suivantes de l'articulation de l'épaule peuvent conduire lors de mouvements normaux à une luxation ou à une subluxation :
1. Détachement du bord antérieur de la cavité glénoïde de l'insertion du ligament gléno-huméral, ce qui dans la plupart des cas se traduit par le désengagement du labrum glénoïdal. Ainsi disparaît l'entrave au glissement en avant de la tête humérale, soit lors de la rotation externe, soit lors de l'extension dorsale.
 2. Défaut dans la surface postérieure de la tête de l'humérus qui permet l'accrochement au bord antérieur de la cavité glénoïde, ce qui est une condition sine qua non, pour qu'une subluxation fixée au-dedans de la capsule articulaire puisse se produire.
 3. Rupture de la capsule selon la description d'*Hybbinette*, dans des luxations de l'épaule plus avancées.
- B. Il ressort des examens de contrôle de 42 malades avec 43 articulations de l'épaule opérées d'après la méthode d'*Eden-Hybbinette*.
1. Aucune récurrence.
 2. Consolidation de la greffe osseuse dans 35 cas sur un total de 36 malades soumis à l'examen radiologique.
 3. La greffe osseuse doit être introduite de telle façon à ce qu'elle se trouve placée sur le même niveau que le plan de la cavité articulaire, et non pas dépassant celui-ci. Il est probable que de cette manière une arthrose déformante pourra être évitée au cours du traitement ultérieur.

4. La tâche assignée à la greffe osseuse n'est vraisemblablement pas le prolongement ou la reconstruction de la cavité glénoïde, mais consiste plutôt en la jonction entre le ligament et la capsule d'une part, et le bord de la cavité articulaire d'autre part.
- C. L'examen de contrôle de 8 cas opérés selon la méthode de Nicola révèle :
1. 3 récidives, l'une d'entre elles d'origine traumatique.
 2. L'un des cas illustre l'insuffisance de la méthode et la nécessité de procéder à une arthrotomie, afin de se rendre compte de l'étendue des dommages infligés.
- D. Un examen de contrôle pratiqué dans 13 cas traités conservativement, c.à.d. non soumis à une intervention chirurgicale, révèle qu'il s'est produit une guérison spontanée dans 3 cas certains.

ZUSAMMENFASSUNG

- A. Die Alterationen im Bereich des Schultergelenkes, die bei normalen Bewegungen eine Luxation oder Subluxation ermöglichen, sind:
1. Eine Ablösung des Ansatzes des Ligamentum glenohumerale von dem vorderen Rand der Cavitas glenoidalis, welche in den meisten Fällen dem Abgleiten des Labrum glenoidale entspricht. Die Sperre für ein Vorwärtsgleiten des Oberarmkopfes, teils bei Aussenrotation, teils bei dorsaler Extension, wird hierdurch aufgehoben.
 2. Ein hinterer Defekt im Oberarmkopf, welcher das Aufhaken an der vorderen Kante der Gelenkfläche ermöglicht. Ohne letztere kann es nicht zu einer innerhalb der Kapsel fixierten Subluxation kommen.
 3. Eine Ruptur der Kapsel, wie nach Hybbinettes Beschreibung, in mehr fortgeschrittenen Luxationsfällen.
- B. Die Nachuntersuchung von 42 Patienten mit 43 nach der Eden-Hybbinette'schen Methode operierten Schultergelenken zeigt:

1. Keine Rezidive.
 2. Ein eingeeihtes Knochentransplantat in 35 von 36 mit Röntgenbild untersuchten Fällen.
 3. Das Knochentransplantat soll in gleicher Höhe mit der Gelenkflächenenebene eingelegt werden und nicht diese Ebene überschreiten. Wahrscheinlich wird auf diese Weise das Aufkommen einer Arthrosis deformans im späteren Verlaufe vermieden.
 4. Ein Ausbau der Cavitas glenoidalis ist wahrscheinlich nicht die eigentliche Aufgabe des Knochentransplantats. Dagegen soll das Transplantat als Verbindungs- bzw. Bindemittel dienen, zwischen Ligamentum und Kapsel einerseits und der Gelenkflächenkante andererseits.
- C. Nachuntersuchung von 8 Fällen, bei denen die Nicola'sche Operation ausgeführt wurde:
1. 3 Rezidive, wovon eine traumatischen Ursprungs.
 2. Einer der Fälle illustriert die Unzuverlässigkeit der Methode und die Notwendigkeit einer Arthrotomie, um den Umfang des Gelenkschadens zu ermessen.
- D. Die Nachuntersuchung von 13 nicht operierten Fällen erweist, dass eine Heilung in 3 sicheren Fällen eingetroffen ist.

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