Studies of the Upper-Extremity Amputee

II. The Population (1953-55)

NORMAN BERGER, M.S.[1]

THE number of upper-extremity amputees examined during the "Survey Studies" conducted by New York University probably represents the largest sample of a single type of disabled individual any research group has thus far had the opportunity to study. The size of the sample (1630 cases) offered a unique opportunity for assessing the status of the upper-extremity amputee on a nationwide basis during the years 1953-55 just prior to the widespread introduction of the devices and techniques promulgated by the Artificial Limb Program. The information that will allow us to form a picture of the arm-amputee population during those years is presented in the following pages under the headings:

General characteristics. This section presents identifying data (such as age, height, weight, and educational level) as well as some general findings concerning causes of amputation, amputee types, and amputee vocations.

Stump characteristics. Here are found data concerning the strength and range of motion of various stump movements, characteristics basic to the control and use of a prosthesis.

Extent of use of prostheses. Under this heading is presented information dealing with the extent and type of prosthetic use in the common activities of daily living, data which permit inferences concerning the functional value of prostheses.

Prosthetic components. This section presents a description of the prostheses worn by arm amputees throughout the country.

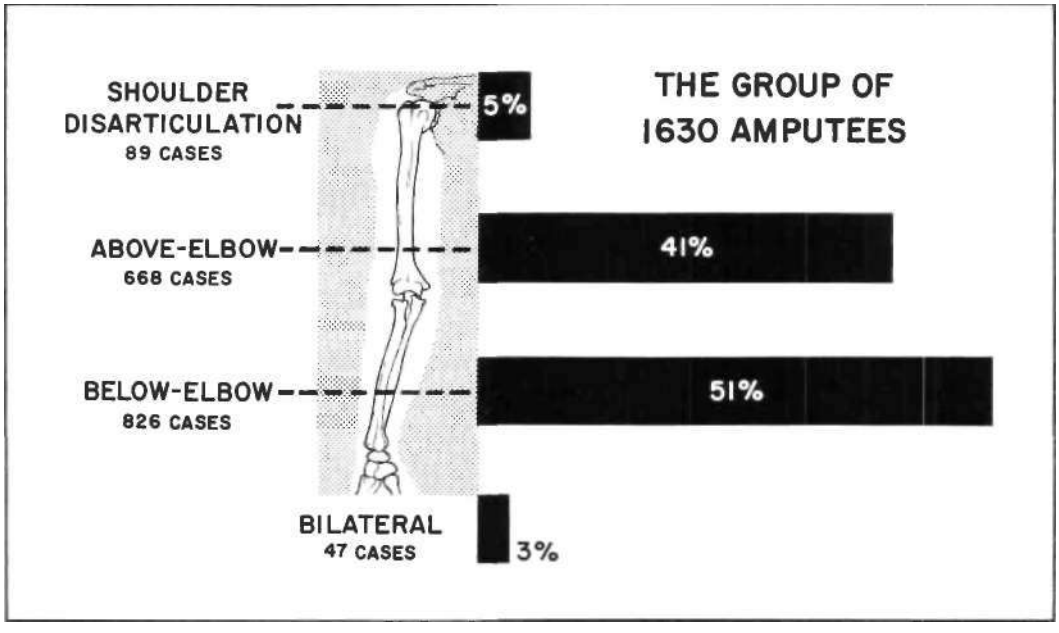
Within this outline, the data gathered are presented, where applicable, by amputee type, an arrangement which permits comparison of attributes between below-elbow, above-elbow, shoulder-disarticulation, and bilateral arm amputees.

One should note at the very outset that this entire study deals with *male* amputees only. No female patients are included anywhere. It will also be noted that the tables and graphs which present the data contain a varying number of cases. Owing to such limitations as the fact that some amputees were not wearing their prostheses or could not remember details about their prosthetic experience, full information was not available for each case. Accordingly, the totals approximate, but are usually somewhat less than, 1630.

GENERAL CHARACTERISTICS

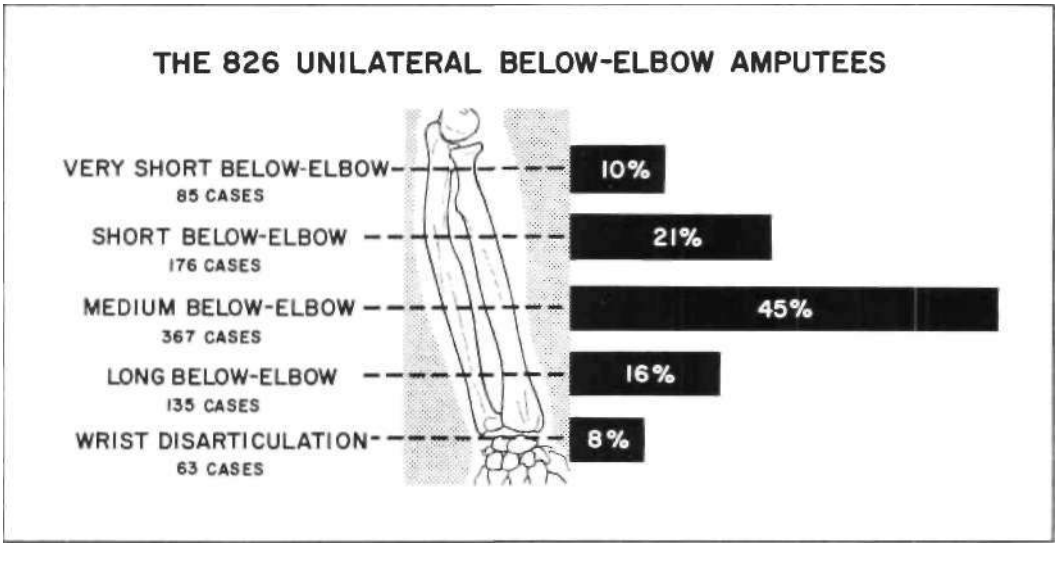
Below-elbow amputees only slightly outnumber above-elbow amputees in the general population. This observation may be somewhat surprising in view of the widespread belief that below-elbow amputations occur much more frequently than do other types. Apparently, the latter is not the case, and it would therefore be unwise to direct research and development toward the one area at the expense of the other. The relative infrequency of shoulder disarticulations and of bilateral arm amputations also is noteworthy.

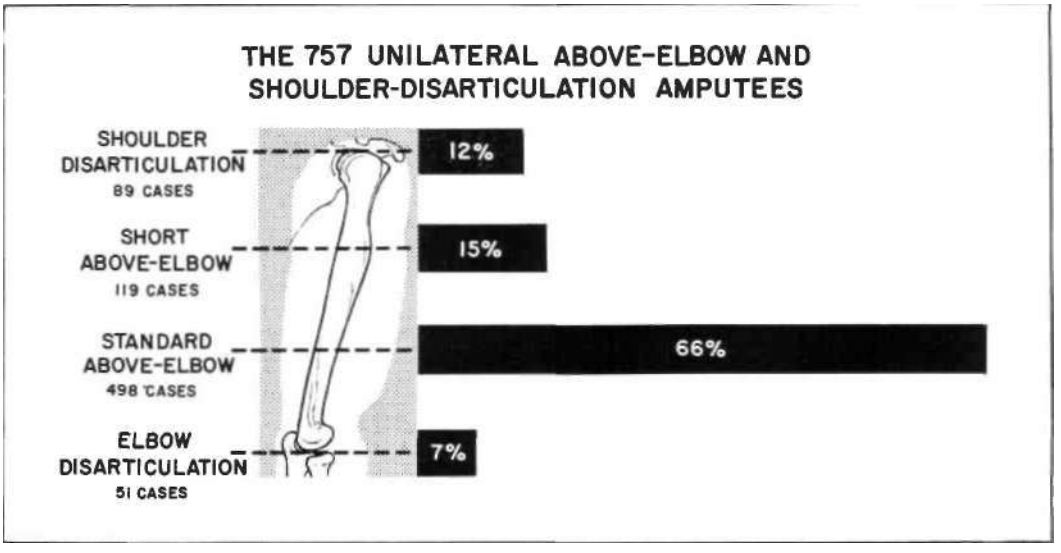
Classification of arm amputees is based on stump length expressed as a percentage of the length of the same arm segment on the sound side. For example, a below-elbow amputee whose stump measures 6 in. from medial



epicondyle to end and whose sound forearm measures 12 in. from medial epicondyle to ulnar styloid has a remaining stump length of 50 percent. The system of classifying arm amputees is thus based on percentage categories, each category indicating a progressively greater amount of loss of function. Because the remaining percentage of the length of the corresponding normal arm segment is an indication of the amount of functional loss occasioned by the amputation, the figure is an important one.

In the NYU survey, the number of amputees in each category was as indicated in the accompanying charts. Nearly half (45 percent) of all below-elbow amputations fall in the

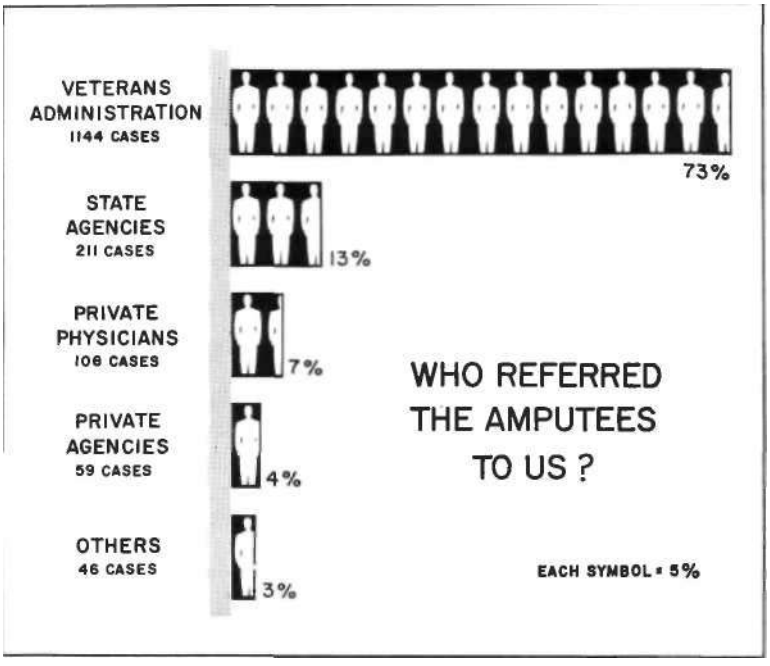




medium below-elbow range, while more than half of the above-elbow cases (66 percent) fall in the standard above-elbow category. Extremely short stumps tend to outnumber extremely long types in both above- and below-elbow cases. Of the below-elbow stumps, 10 percent are very short as compared to 8 percent that are wrist disarticulations; in the above-elbow group, 12 percent are shoulder disarticulations as compared to 7 percent that are elbow disarticulations.

A very substantial portion of the amputees contacted during the survey studies were veterans whose amputations were service-connected and who were receiving prosthetic treatment through the Veterans Administration. This preponderance of veteran amputees should be borne in mind, since it may tend to affect the data in some respects.

With the large number of veterans in the sample, it is not surprising that over half of the amputations were caused by combat injuries. Aside from wartime casualties, most upper-extremity amputations result from trauma, less than 5 percent being either of congenital origin or due to disease.



The average age of the group (Table 1) is 36 years, but in view of the large number of veterans in the sample it is difficult to say whether this age distribution is representative of the entire amputee population. It is likely that significant numbers of cases in the older age groups are not included in these data.

Tables 2 and 3 give respectively the heights and weights of the subjects studied. Table 4 gives the residence of the subjects by state.

Almost four out of five of the amputees in the survey group were married (Table 5). There has been speculation about a possible relationship between the extent of handicap and marital status. In this regard, the following breakdown may be of interest:

	Below-Elbow	Above-Elbow	Shoulder Disarticulation	Bilateral
Percentage that were single	19	21	32	26

While there is some indication of a trend in these figures, their significance must await additional data bearing on this point.

Table 6 presents the educational level of the subjects, but here again the data may be biased by the fact that a large portion of the group was eligible for educational benefits through the Veterans Administration or State Vocational Rehabilitation Divisions. The effect of these influences on the data cannot be assessed without further study.

Amputation in the upper extremity apparently results in a definite occupational shift primarily away from agricultural and other forms of manual labor at all levels of skills and toward managerial, clerical, sales, and office work. Prior to amputation, professional-managerial, clerical, and sales jobs accounted for 14 percent of the sample's vocations, while agricultural, skilled, semiskilled, and unskilled jobs accounted for 64 percent. In contrast, the former groups of jobs include 41 percent of the postamputation occupations (an increase of 27 percentage points), and the latter groups include 27 percent (a decrease of 37 percentage points).

Another marked shift occurs in the rate of unemployment. Whereas only 1 percent of the group was unemployed prior to the loss of an arm, 19 percent were not gainfully employed when seen at amputee clinics.

Table 2

HEIGHT OF THE SUBJECTS

No. Cases	Height	Percent of Total
35	Under 5′4″	2
80	5′4″ but less than 5′6″	5
276	5′6″ but less than 5′8″	17
393	5′8″ but less than 5′10″	25
469	5′10″ but less than 6′0″	29
257	6′0″ but less than 6′2″	16
92	6′2″ and over	6
Total 1602		

Table 1

AGE OF THE SUBJECTS

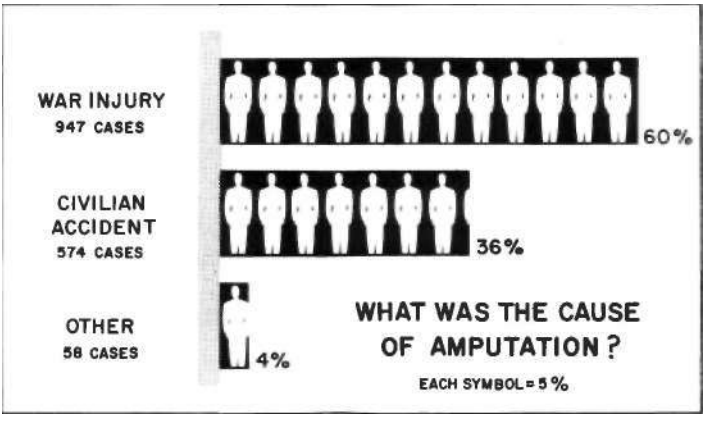
No. of Cases	Age (years)	Percent of Total
69	15–19	4
406	20–29	25
734	30–39	45
253	40–49	16
106	50–59	6
46	60–69	3
8	70 and over	1
Total 1622		

Table 3

WEIGHT OF THE SUBJECTS

No. Cases	Weight (lb.)	Percent of Total
23	Under 120	2
176	120–139	11
443	140–159	28
522	160–179	32
289	180–199	18
95	200–220	6
54	Over 220	3
Total 1602		

It is interesting to note that those amputees who were employed were occupied in a wide variety of jobs including agricultural and skilled vocations. This fact leads us to speculate as to the reasons for these occupational shifts. Are these trends actually caused by the physical inability of the amputee to perform and compete, or are there perhaps other social or psychological reasons for the occupational shift? Doubtless, a combination of factors is operative, but the relative importance of each is still unknown.



STUMP CHARACTERISTICS

The stump characteristics with which we are concerned in this section are strength and range of motion. Information about these characteristics was obtained through goniometric measurements and standard muscle-testing techniques.

In general, the below-elbow amputee retains somewhat more range of pronation than of supination (Table 7). The average amount of residual pronation in the entire sample is

Table 4

RESIDENCE OF THE SUBJECTS BY STATE

Alabama	24	Nebraska	16
Arizona	0	Nevada	0
Arkansas	3	New Hampshire	0
California	157	New Jersey	65
Colorado	38	New Mexico	3
Connecticut	1	New York	70
Delaware	1	North Carolina	13
District of Columbia	12	North Dakota	0
Florida	27	Ohio	120
Georgia	38	Oklahoma	61
Idaho	0	Oregon	25
Illinois	24	Pennsylvania	163
Indiana	1	Rhode Island	10
Iowa	32	South Carolina	0
Kansas	24	South Dakota	0
Kentucky	41	Tennessee	61
Louisiana	39	Texas	79
Maine	3	Utah	25
Maryland	29	Vermont	0
Massachusetts	73	Virginia	27
Michigan	129	Washington	33
Minnesota	48	West Virginia	3
Mississippi	7	Wisconsin	16
Missouri	86	Wyoming	3
Montana	0	Total	1630

Table 5

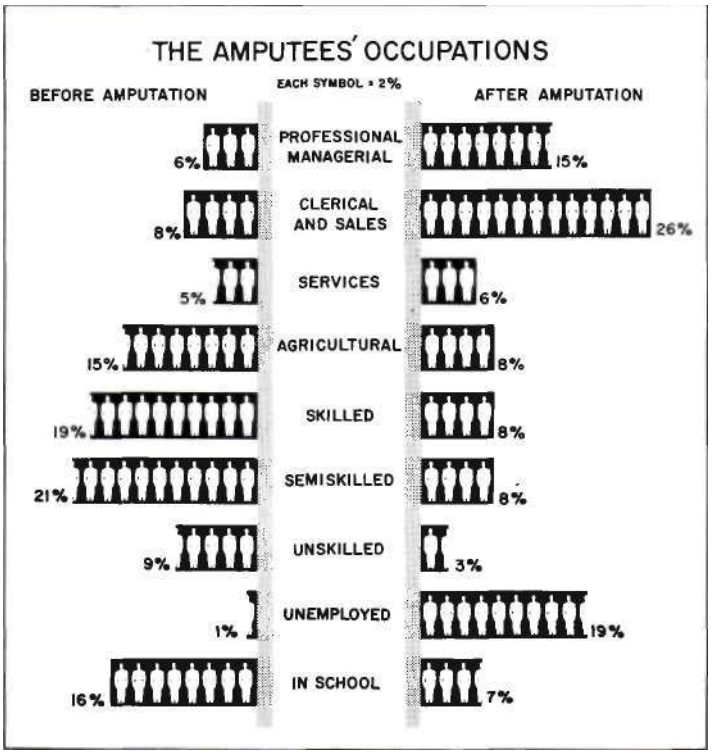
MARITAL STATUS OF THE SUBJECTS

No. Cases	Status	Percent of Total
320	Single	21
1199	Married	79
Total 1519		

Table 6

EDUCATIONAL LEVEL OF THE SUBJECTS

No. Cases	Education	Percent of Total
461	Attended or completed grade school	28
737	Attended or completed high school	45
336	Attended or completed college	21
88	Performed graduate work	6
Total 1622		



38 deg., the average amount of supination being 33 deg.

Besides retaining somewhat more range of motion in pronation than in supination, the below-elbow amputee tends to have somewhat greater strength of pronation (Table 8). The strength of pronation was rated good or excellent in 57 percent of the cases while 51 percent were rated good or excellent in supination.

Of the total group, 75 percent were able to flex their elbows actively to an angle of 130 deg. or more (Table 9). Among below-elbow amputees, then, approximately three out of four cases retain a normal amount of elbow flexion on the side of the amputation. On the other end of the scale, however, it should be noted that a significant number of amputees have a restricted range of motion and require special prosthetic or medical attention in order to achieve a more normal flexion angle.

Whereas somewhat more than 50 percent of the cases had good or excellent strength in pronation and supination, 90 percent had equivalent strength ratings in elbow flexion (Table 10), as would be expected since amputation through the forearm interferes less with the muscles and joints related to elbow flexion than with those related to pronation and supination.

When wearing a prosthesis, the above-elbow amputee rarely has occasion to move his

Table 7

RANGE OF PRONATION-SUPINATION

Pronation		Range (deg.)	Supination	
No. Cases	Percent of Total		No. Cases	Percent of Total
262	32	Below 10	276	34
102	13	10–29	155	19
172	21	30–49	178	22
127	15	50–69	98	12
80	10	70–89	49	6
70	9	90 or more	57	7
Total 813			813	

Table 8

STRENGTH OF PRONATION-SUPINATION

Pronation		Strength	Supination	
No. Cases	Percent of Total		No. Cases	Percent of Total
215	28	Excellent	194	25
224	29	Good	199	26
103	13	Fair	132	17
19	3	Poor	21	3
209	27	Trace or none	224	29
Total 770			770	

stump beyond an angle of 80 deg. either in elbow flexion or in abduction of the humeral stump. On this basis, the majority of above-elbow amputees have more than adequate range of motion for present conventional prostheses. The data indicate that 94 percent of the cases had 80 deg. or more of flexion; 91 percent had 80 deg. or more of abduction (Table 11).

The motion of extension at the shoulder joint is used primarily in locking and unlocking the prosthetic elbow. To perform this operation, an extension range of 40 deg. is more than adequate. In our sample, 82 percent of the cases could achieve an extension angle of 40 deg. or more.

The majority of above-elbow amputees have no significant problem with regard to the strength of motions at the shoulder joint. In the total group, 90 percent of the cases had good or excellent strength in flexion, 81 percent had good or excellent strength in extension, and 90 percent had good or excellent strength in abduction (Table 12).

EXTENT OF USE OF PROSTHESES

In assessing the extent of prosthetic use, information was obtained as to the length of time the prosthesis was worn, if at all, and as to the specific activities for which it was used in dressing, eating, work, and recreation. These data permit inferences to be made concerning the usefulness of the prosthesis in everyday life.

A surprisingly large portion (62 percent) of the amputees indicated that they were

Table 9

RANGE OF ELBOW FLEXION

No. Cases	Range (deg.)	Percent of Total
58	Under 90	7
21	90–99	2.5
21	100–109	2.5
39	110–119	5
62	120–129	8
297	130–140	36
318	Over 140	39
Total 816		

Table 10

STRENGTH OF ELBOW FLEXION

No. Cases	Strength	Percent of Total
393	Excellent	50
308	Good	40
60	Fair	8
14	Poor	2
4	Trace or none	Negligible
Total 779		

Table 11

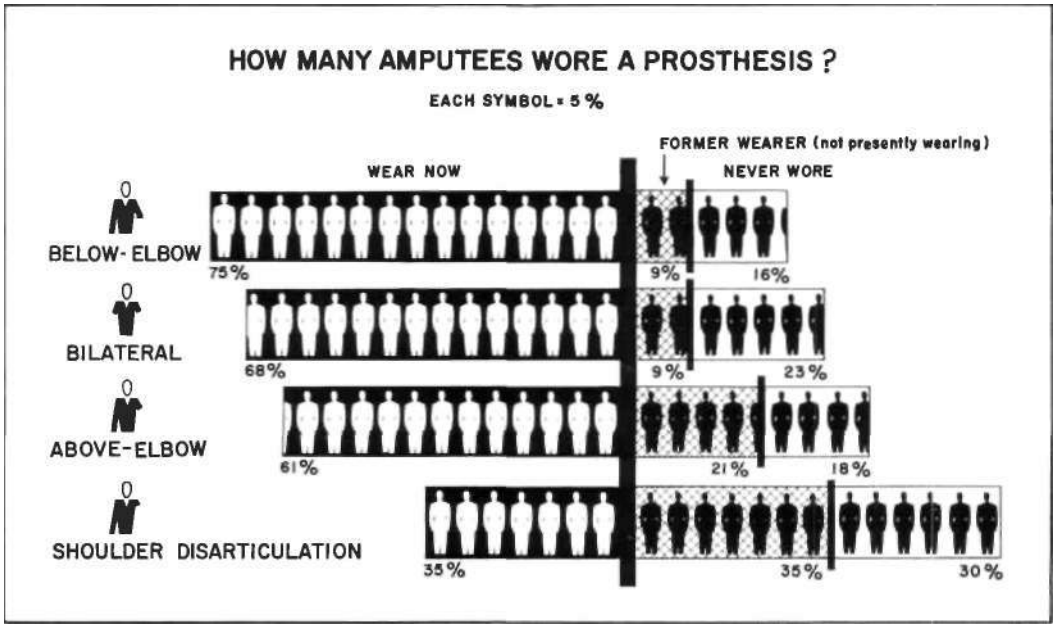
RANGE OF HUMERAL FLEXION, EXTENSION, AND ABDUCTION IN ABOVE-ELBOW CASE

Flexion		Extension		Range (deg.)	Abduction	
No. Cases	Percent of Total	No. Cases	Percent of Total		No. Cases	Percent of Total
9	1	31	5	Under 20	13	2
2	1	86	13	20–39	8	1
11	2	286	42	40–59	18	3
11	2	201	30	60–79	19	3
35	5	69	10	80–99	83	13
54	8	—	—	100–120	107	16
530	81	—	—	Over 120	404	62
Total 652		673			652	

Table 12

STRENGTH OF HUMERAL FLEXION, EXTENSION, AND ABDUCTION IN ABOVE-ELBOW CASE

Flexion		Extension		Range (deg.)	Abduction	
No. Cases	Percent of Total	No. Cases	Percent of Total		No. Cases	Percent of Total
307	48	227	39	Excellent	290	46
269	42	246	42	Good	276	44
44	7	87	15	Fair	52	8
6	1	11	2	Poor	4	1
8	2	12	2	Trace or none	10	1
Total 634		583			632	



prosthesis wearers at the time of the survey, but this figure may be deceivingly high because of the large number of veterans in the sample. Moreover, the term "present wearer," while it indicates daily wear, does not indicate the actual *amount of time* the prosthesis is worn. Some of these "present wearers" may use the prosthesis only a short time each day. Further information bearing on this point is to be found in the accompanying chart dealing with the number of hours per week the prosthesis was worn.

It is perhaps more informative to notice how the wear status varies with increasing severity of loss. While 75 percent of the below-elbow amputees were classified as present wearers, this figure drops to 61 percent for the above-elbow amputees and to 35 percent for the shoulder-disarticulation cases. Clearly there are considerably fewer unilateral arm amputees wearing prostheses as the level of amputation moves proximally.

The same trend is found among amputees who had worn prostheses before but who had given them up and were nonwearers at the time of the survey. Among the below-elbow amputees, 9 percent were nonwearers although they had had previous prosthetic experience. Among the above-elbow amputees, this figure rises to 21 percent and reaches 35 percent among the shoulder-disarticulation cases.

From these data, the inference is inescapable that, while the below-elbow prosthesis was a fairly widely worn device, the prosthetic replacement for the above-elbow case and that for shoulder disarticulation left more to be desired.

A significant portion of those amputees who wear prostheses apparently use them full-time, *i.e.*, 80 or more hours per week, which is about the equivalent of 12 hours a day, every day. In this respect there are, however, significant differences among the several amputee categories. For example, 71 percent of the below-elbow amputees were full-time wearers. But for the above-elbow and shoulder-disarticulation groups, this figure drops to 53 percent and 54 percent, respectively. Among bilaterals the figure rises to 88 percent; the bilateral is obviously more dependent on his prosthesis than is the corresponding unilateral amputee.

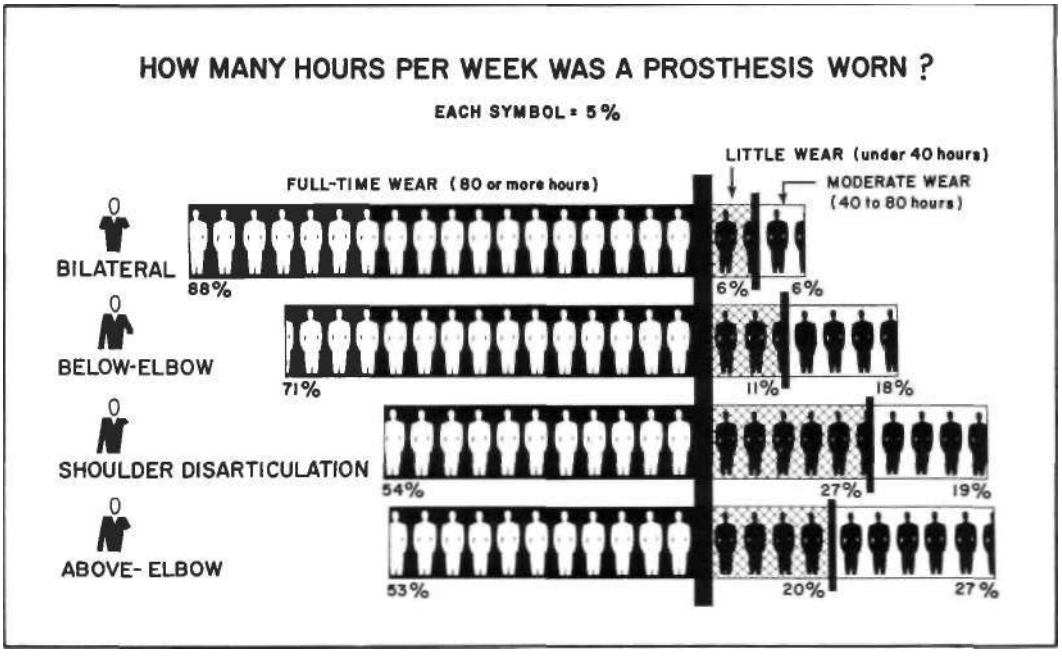
The conclusion that the amount of wear decreases significantly as the level of unilateral

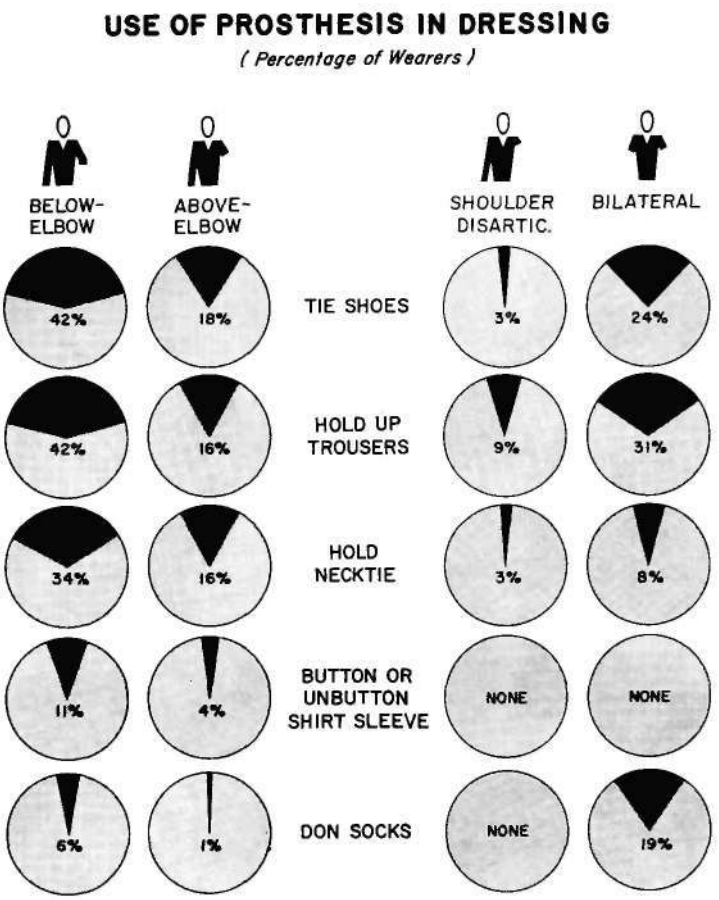
amputation becomes higher is reinforced by the data pertaining to the percentage of amputees who wear their prostheses for relatively short periods each week. A wearing time of less than 40 hours per week was reported by 11 percent of the below-elbow group, 20 percent of the above-elbow group, 27 percent of the shoulder-disarticulation group, and 6 percent of the bilaterals. Judging from these data, individuals with amputations above the elbow do not receive sufficient value from their prostheses to wear them consistently.

We come now to a consideration of the degree of actual use to which arm prostheses are put by those who wear them. The activities listed in the four accompanying charts have two important characteristics. First, they are extremely common, being performed several times daily by almost every active individual. They are an inescapable and integral part of normal daily life. Secondly, they are bimanual in nature, either requiring two hands directly or else necessitating the use of one hand while the other is occupied in an auxiliary role. For these reasons, the use or nonuse of the prosthesis in these activities can properly be considered an indicator of the value of the replacement.

We have already seen that some amputees had never worn a prosthesis and that others had given one up after some trial period. While the situation is quite complex, these facts point out that, at least for a certain number of amputees, the prosthesis did not offer sufficient functional advantage to compensate for any inconvenience or discomfort involved in its use. But what of those amputees who did wear their appliance? Did they use their artificial arms to assist in the accomplishment of these common activities?

In the activities of dressing, we find that 42 percent of the below-elbow amputees *did* use their prostheses in tying shoe laces and in holding up the trousers while the sound hand adjusted buttons, zippers, or belts. This figure, however, is considerably reduced in the case of the above-elbow amputee and is even smaller for the shoulder-disarticulation cases. The information can be summarized by saying that, first, significantly less than half of those amputees who wear arm prostheses





use them in dressing activities and, second, that use of an arm prosthesis in dressing decreases markedly the more proximal the level of amputation.

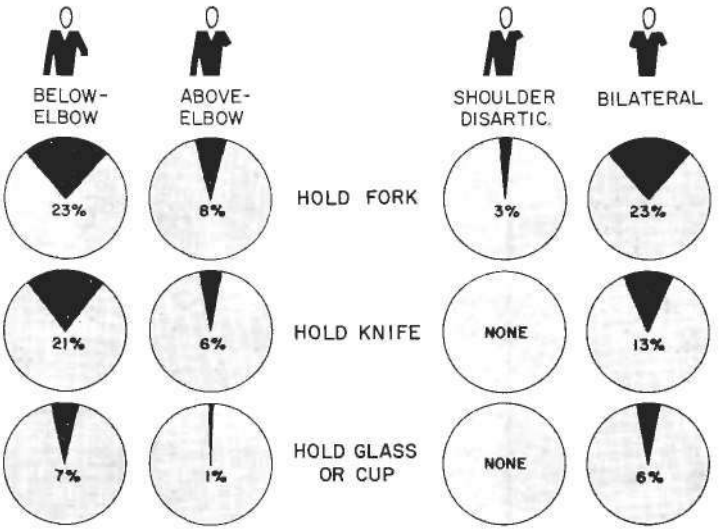
Although it is customary for the normal person to use a knife and fork in cutting food, apparently most arm amputees adopt some other method. It should be recalled that the use of two hands for eating activities is mandatory in only a few instances, such as in cutting tough meat or in buttering bread. The amputee can try to avoid these situations, can receive help from another person, or can use a special tool such as a combination knife-fork. At any rate, it seems clear that, in the area of eating, the prosthesis was not of great functional value to the sample group. The highest rate of use was only 23 percent (among the below-elbow and the bilateral subjects, who reported holding a fork in the prosthesis).

Light grasp is differentiated from heavy grasp not only by the weight of the object but also in that precision is the essential feature of the former while strength of grip is paramount in the latter. Holding papers and writing implements are examples of light grasp; handling tools exemplifies heavy grasp. The word "support" is here used to indicate holding an object up, as in carrying a topcoat, not by grasping but by placing a terminal device or prosthetic forearm underneath it. "Weight" implies holding an object down in the fashion of a paperweight, again without grasping.

As regards work activities, the data on use of an arm prosthesis present much the same

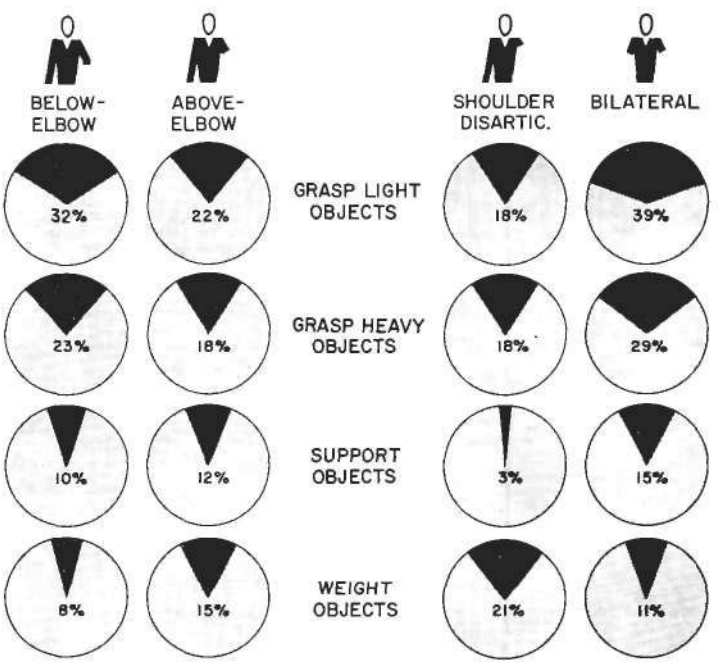
USE OF PROSTHESIS IN EATING

(Percentage of Wearers)



USE OF PROSTHESIS AT WORK

(Percentage of Wearers)

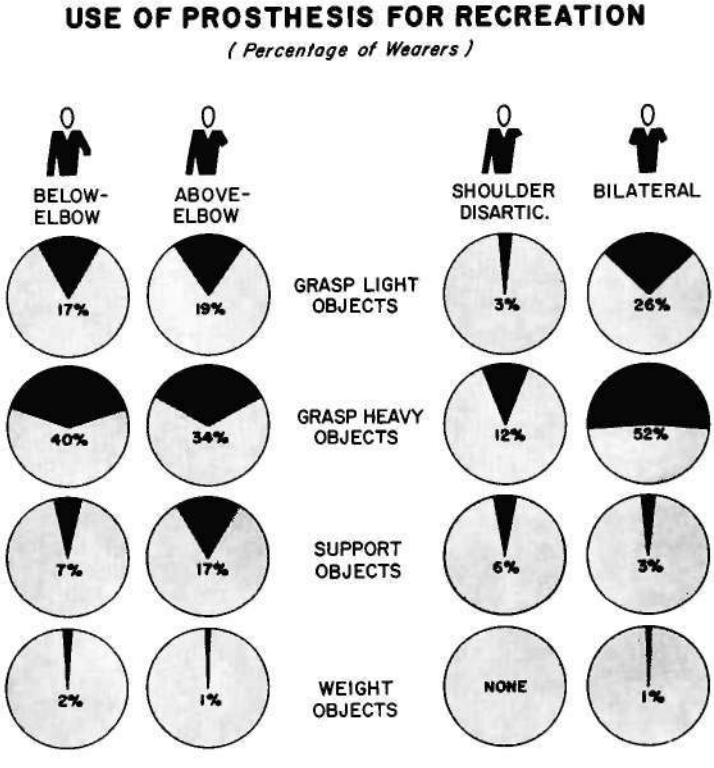


picture as we have seen in connection with dressing and eating. The majority of the group still report no use of their prostheses, and again the amount of use at work declines at the higher amputation levels. It is interesting to note, however, that in this area there is much less decrease in use among above-elbow and shoulder-disarticulation amputees than is the case in the other two areas (dressing and eating). That is to say, the above-elbow and shoulder-disarticulation prosthesis was used more often for work tasks than for eating or dressing. This may be accounted for by the social and competitive pressures in job situations, or perhaps by the fact that work tasks are extremely varied as compared to the restricted number and type of activities in dressing and eating.

As for activities involved in recreation, the number of amputees reporting use of the prosthesis for grasp of heavy objects is more than double the number reporting light grasp. This reversal of the data dealing with use of the prosthesis at work raises a number of questions. Does the amputee find himself placed in jobs whose demands are quite light physically? And, if so, is this a real or an imagined limitation, since apparently the amputee is able to and tends to do heavier activities for his own recreation than he does on the job? It may be that there is an existent prejudice, not in accord with the facts, concerning the kind of activity that an arm amputee can perform. Such a misconception, on the part either of the amputee or of other persons such as vocational counselors, could lead to placement in jobs requiring activity levels lower than those which the amputee is capable of producing.

PROSTHETIC COMPONENTS

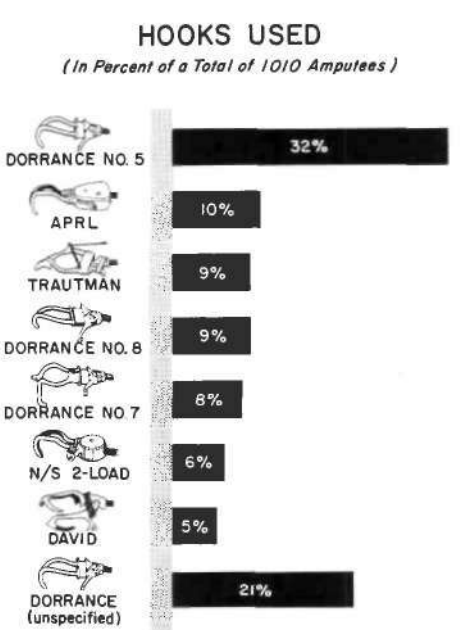
In this section we are concerned primarily with the types of prosthetic equipment worn by arm amputees throughout the country just prior to the research studies. For convenience, we shall deal first with those pros-

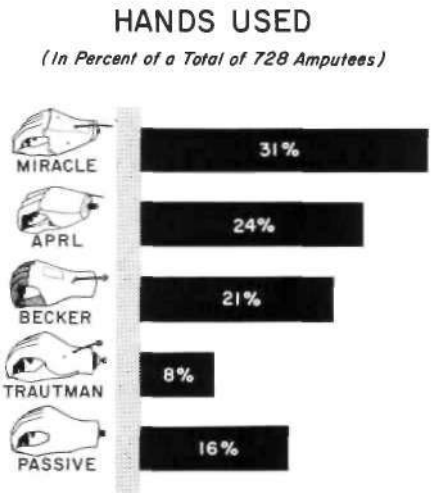


thetic components that are common to all prostheses and then proceed to components that are specific to below-elbow and to above-elbow arms.

At the time of this survey of upper-extremity amputees, the voluntary-opening Dorrance No. 5 was by far the most widely used hook. Over 32 percent of the group wore it. In all, the Dorrance hooks, of which there are numerous types, were worn by 70 percent of the subjects, the No. 8 and the No. 7 following behind the No. 5 in popularity. Other hooks that had a fairly widespread use were the APRL voluntary-closing hook (10 percent of all the amputees) and the Trautman hook (9 percent).

The three hands that had been most widely dispensed were the Miracle (31 percent of the group), the APRL (24 percent), and the Becker (21 percent). In addition to the relative numbers of the various types of hands, it is interesting to note that 84 percent of the sample used active hands as compared to 16 percent who wore passive hands. Also, as one would expect, the total number of hands worn (728), while quite high, is substantially less than the total number of hooks (1010). Many amputees owned both a hand and a hook.

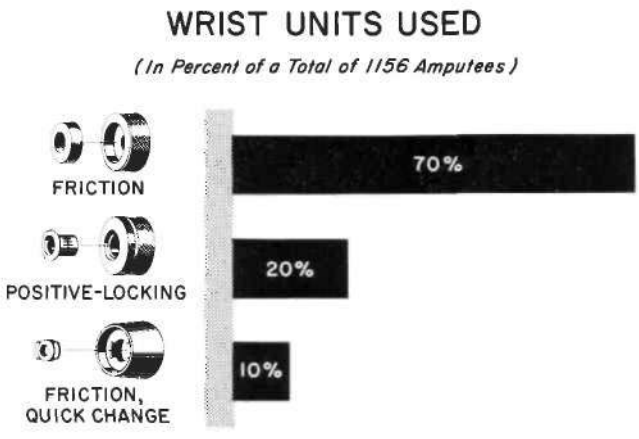




It is clear that at the time of the survey the great bulk of arm amputees (70 percent) used friction wrist units. The positive-locking type of wrist unit was worn by 20 percent of the group, and approximately three out of four of these units were of the Hosmer WD-400 type. The proportion of positive-locking wrists remained fairly constant in all groups except that of the bilaterals, who would be expected to have difficulty in operating this unit. Among the arms worn by bilaterals, only two were equipped with positive-locking wrists.

The remaining 10 percent of the sample wore the quick-change Dorrance "Butterfly" type of wrist, which is essentially a friction unit with provision for quick interchange of terminal devices.

Considering the group as a whole, plastic sockets were used most extensively. Forty-three percent of the subjects wore this type as compared to 37 percent who wore sockets made of leather, 12 percent whose sockets were made of wood, and 9 percent with fiber sockets. Since plastic is the standard socket material today, it is interesting to note that



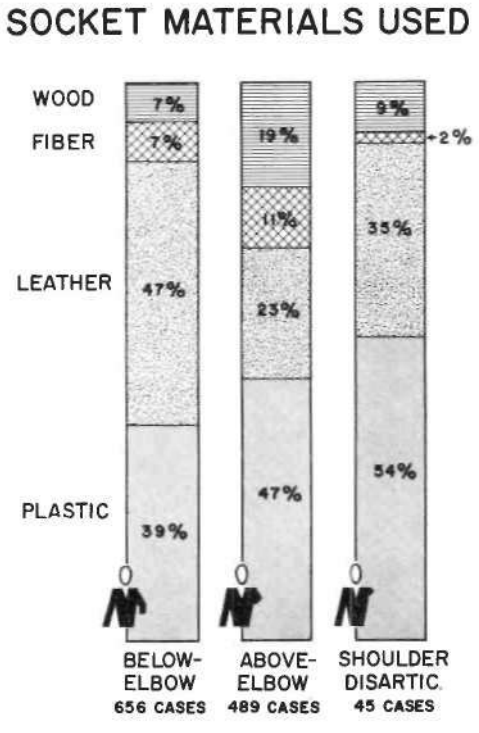
57 percent of the entire group did not wear plastic sockets at the time of the survey.

There was, however, considerable variation among the below-elbow, above-elbow, and shoulder-disarticulation groups. The leather socket was used by a substantial portion of the below-elbow population (47 percent) but by smaller segments of the above-elbow and shoulder-disarticulation groups (23 percent and 35 percent respectively). Approximately half of this latter group (above-elbow and shoulder disarticulation) wore plastic sockets.

It is interesting to note that at the time of the survey there was still fairly prevalent use of wood for the above-elbow socket (19 percent of the cases) and of molded leather for the shoulder-disarticulation socket *(35* percent of the cases). The data also indicate that over 79 percent of the below-elbow and over 86 percent of the above-elbow sockets were of single-wall construction. Double-wall sockets, which have many functional and cosmetic advantages, were not in general use.

The harnesses worn by arm amputees at the time of the survey present quite different pictures in the below-elbow and above-elbow groups. The bulk of the below-elbow population (63 percent) used standard figure-eight harnesses, and an additional large group (25 percent) wore a single axilla loop. These two types of harnesses differ only in that the axilla loop does not contain the front suspension strap (commonly in the form of an inverted F) of the figure-eight harness. The other major style of below-elbow harnessing is the chest strap and shoulder saddle, which was worn by 12 percent of the sample.

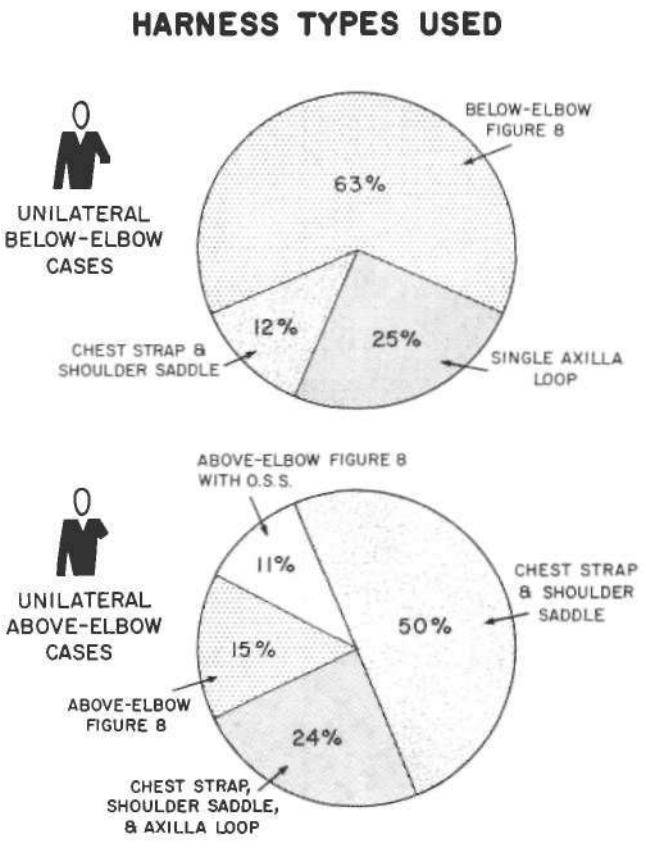
Turning to the above-elbow population, we find the situation reversed. Fifty percent of this group wore a shoulder saddle and chest strap, while another 24 percent wore the same harness *plus* an axilla loop to which the control cable was attached. Thus, three quarters of the above-elbow sample had shoulder saddles and chest straps as their



basic suspensory harness. The remaining one quarter of all above-elbow amputees wore figure-eight harnesses, either with or without the over-the-shoulder strap.

The most universally used elbow joint was the polycentric rigid joint. It was found in 57 percent of the below-elbow arms (Table 13). If we add to this figure the three other types of rigid hinges listed in the accompanying table, we find that 70 percent of the below-elbow sample wore rigid elbow joints. The remaining 30 percent wore flexible or semiflexible joints.

Beginning with the triceps pad, a relatively small section of leather located on the posterior side of the humerus, each type of upper-arm cuff is progressively larger. The half cuff covers approximately half of the upper-arm circumference, the full cuff completely encircles the arm, and the three-quarter cuff is between these two in size.



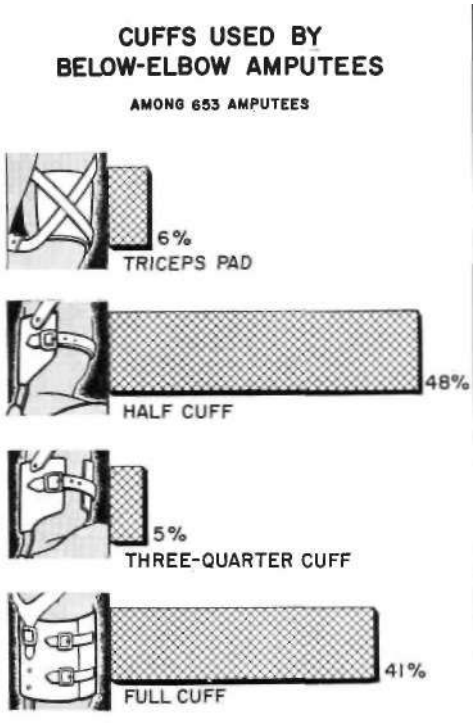
A principle generally agreed upon is that the less cuffing used the more comfortable and convenient is the prosthesis, provided that stability and control are not impaired. It is noteworthy, therefore, that the smallest cuff, the triceps pad, was worn by only six percent of the cases. The half and full cuffs were worn almost exclusively (48 and 41 percent of the sample, respectively).

Almost all of the half and full cuffs were worn with one or two billets. One of the factors accounting for the large number of full cuffs and supportive billets, which contrasts markedly with present practice, may have been the previously noted prevalence of the axilla-loop harness, which has no front suspension strap.

Slightly more than half of all above-elbow amputees did not use automatic, harness-

Table 13
ELBOW HINGES USED

No. Cases	Joint	Percent of Total
385	Polycentric rigid	57
120	Flexible	18
80	Semiflexible (insert)	12
55	Rigid, type unspecified	8
16	Step-up	2
14	Single-axis rigid	2
4	Locking rigid	1
Total 674		



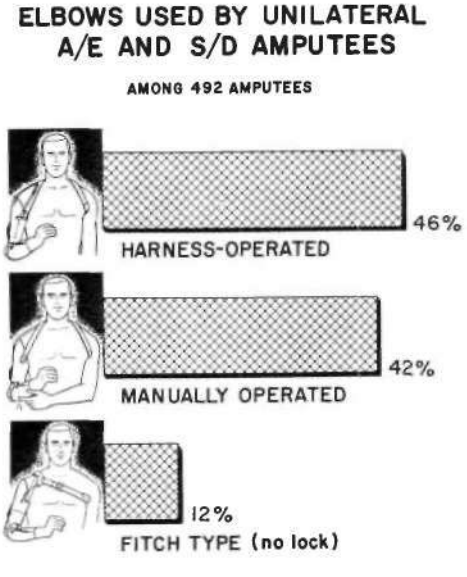
controlled elbow units, which are considered standard equipment today. Of this group, 42 percent were manual locks operated by the remaining sound hand, while the remainder (12 percent) wore Fitch-type elbows, which do not contain a locking mechanism.

Of the slightly less than half who did wear harness-operated elbow-locking units, 25 percent used Hosmer units (primarily the E-300 elbow) and 21 percent used Sierra units (the Model C elbow).

SUMMARY

The past five years have witnessed a rapid change in the field of upper-extremity prosthetics, partly as a result of the education program and of the studies reported in this issue of ARTIFICIAL LIMBS. AS a step in the measurement of the progress that has been and will be made, the survey studies were designed to provide a baseline describing the state of upper-extremity prosthetics prior to the introduction of new techniques, devices, and concepts of amputee management.

To establish this baseline, information has been presented about a sample of 1630 amputees observed during the years 1953-55. The character and status of the entire upper-extremity amputee population in 1953-55 can reasonably be inferred from these data. The extremely large number of all types of male amputees who participated, the nationwide scope of the survey, the inclusion of wearers and nonwearers, and the wide variety of occupations represented make for confidence



in the accuracy with which the state of the art has been depicted.

The primary limiting factor in these data is the large number of veterans among the group, which undoubtedly influences the results. In addition, the data tend to characterize those amputees who reside in urban areas or within a 100-mile radius of the major metropolitan centers where the participating clinics were located. Hence it is likely that the rural resident is not fully represented.