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RELATIVE INCIDENCES OF NEW AMPUTATIONS
Statistical Comparisons of 6,000 New Amputees[1]

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Because of the methods employed in the delivery of health services in the United States, it has not been practical to conduct accurate census studies of the amputee population; and, except for data on Veterans Administration beneficiaries, little is known generally about the characteristics of individuals who have lost their limbs.

In 1964 Dr. Harold W. Glattly published the results of a survey of new amputees *(1)* he conducted with the assistance of members of the American Orthotic and Prosthetic Association (AOPA) during the period October 1, 1961–January 31, 1963. Data were obtained on more than 12,000 amputees who presented themselves for fitting of an artificial limb for the first time. The study was the first of its kind, and the results have been of interest and use to many practitioners, research workers, and administrators.

In 1973-74, the Committees on Prosthetics Research and Development and Prosthetic-Orthotic Education (CPRD-CPOE) conducted an identical study to determine whether the characteristics of the current amputee population were any different from those recorded by Glattly.

Procedures identical to those used in the first study were employed so that valid comparisons could be made.

In his study Glattly found that there was no change in the ratios obtained when data from the first 5,000 cases were compared with those obtained from the total sample of 12,000. In the 1973-74 study, data from the first 1,654 cases were analyzed *(2)* and compared later with data from 5,830 cases. Because there were no practical differences in the ratios obtained, the study was concluded.

Thus, it is felt that the data presented accurately reflect current incidences of amputation practice. However, it should be emphasized that neither this study nor the one reported by Glattly was conducted in conformance with scientific sampling techniques.

A comparison of the new reading with Glattly's final report reveals some apparently significant changes in amputation statistics, as well as some situations where very little change seems to have occurred during the past 12 years.

METHOD

One hundred and forty-three prosthetics facilities, all members of AOPA, in 39 states and the District of Columbia, participated (Fig. 1). Two simple data-collection forms were devised by Dr. Glattly. To gather the same type of information, similar forms, updated for computer programming, were used in the current study (Figs. 2 and 3). The participating facilities were provided packets of the forms, which contained original data slips to be retained by them for future reference, as well as carbon copies in the form of addressed and stamped postcards for mailing to CPRD-CPOE. Participants were instructed to complete a card on each new amputee for whom an original prosthetic device was provided. Amputees furnished with a replacement prosthesis were not recorded in either study. Card No. 1 was used for single amputations or multiple amputations done simultaneously for a single cause. Card No. 2 was prepared for cases in which more than one amputation was done at separate times for either the same or different causes—for

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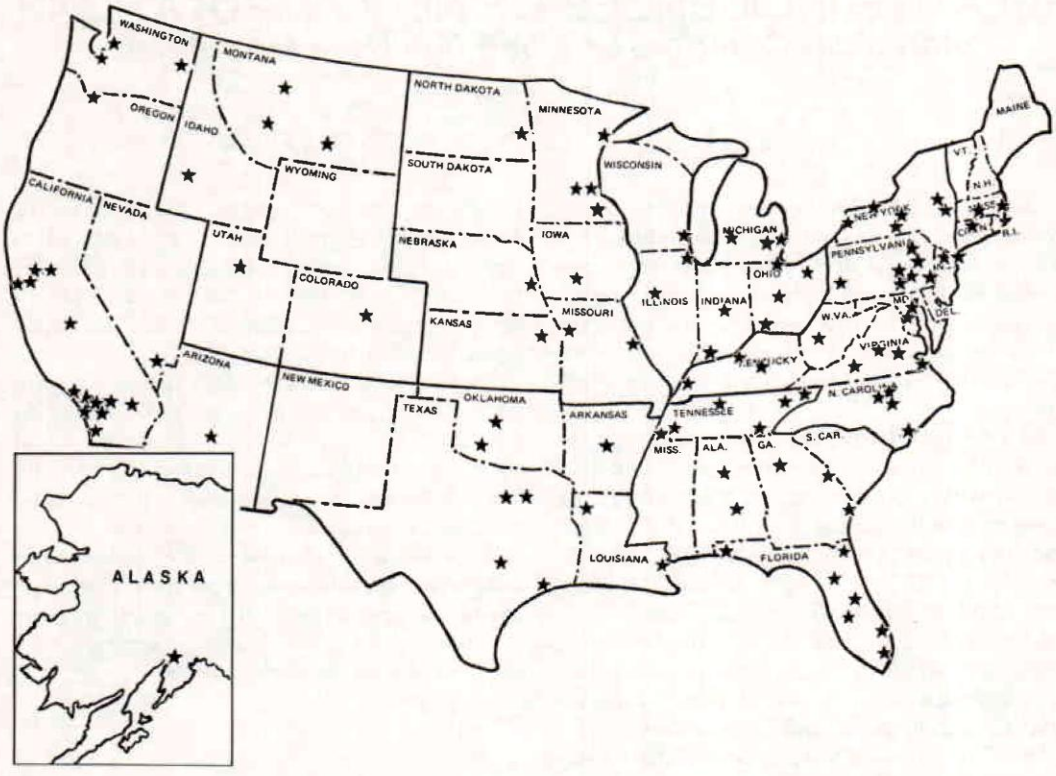


Fig. 1. Distribution map showing locations of prosthetics facilities participating in Amputee Survey.

example, an individual who had a below-knee amputation revised at a later date to the above-knee level. This type of patient represents a "new" case in the sense that his above-knee limb remnant had never been fitted previously. To indicate sex, site, and causes of amputation, numbers adjacent to the appropriate information were circled.

Causes of amputation were grouped under four categories:

Trauma. Amputations due to physical and thermal injuries, and to infection following injury.

Disease. Amputations due to vascular diseases and infections.

Tumor. All types of growths for which an amputation is performed.

Congenital. Only cases in which prostheses were fitted were included. The type of prosthesis was used to determine the "amputation" level.

FINDINGS

SEX

Glattly found that, in the total survey population, the ratio of males to females undergoing amputation (Table l) was better than 3 to 1 (77 to 23 percent). In the present study the proportion of males had dropped slightly, with a corresponding proportional increase in females (72 to 28 percent).

Glattly concluded that the disparity in amputation rates for males and females was attributable largely to the fact that amputations by reason of injury occurred nine times as frequently in males as they did in females (Table 2). In the current study males still predominated, but the trauma ratio had dropped to 7.2 to 1. The proportion of males to females coming to amputation because of disease had dropped slightly—2.6 to 1 versus 2.1 to 1, but it is somewhat doubtful whether this change is of any significance.

CPRD-CPOE/AOPA AMPUTEE SURVEY 1973-74 **Case**

Name_____ Code_____

State_____ Age_____ Sex: M F

Date of Most Recent Amputation_____ Site_____ Cause_____

Date Prosthesis Furnished_____

PRIOR AMPUTATION(S)			
	Date	Site	Cause
First			
Second			
Third			

ORIGINAL – RETAIN IN YOUR FILE

Fig. 2. Amputee Survey Card No. 1. Data form for single amputations and multiple amputations resulting from a single cause at the same time.

CPRD-CPOE/AOPA AMPUTEE SURVEY 1973-74 **Case**

Name_____ Code _____ (1-3) (4-6)

State_____ Age_____ (7-8) Sex: (9) M F

Date of Amputation(s)_____ (10-15) Date Prosthesis Furnished _____ (16-21)

SITE(S) OF AMPUTATION							
RU (22)		RL (23)		LU (24)		LL (25)	
1	SD	1	HD	1	SD	1	HD
2	AE	2	AK	2	AE	2	AK
3	ED	3	KD	3	ED	3	KD
4	BE	4	BK	4	BE	4	BK
5	WD	5	S	5	WD	5	S

CAUSE OF AMPUTATION (26)
1 Trauma
2 Disease
3 Tumor
4 Congenital

ORIGINAL – RETAIN IN YOUR FILE

Fig. 3. Amputee Survey Card No. 2. Data form for multiple amputations of the same limb, occurring serially at different times from the same or different causes.

Table 1.

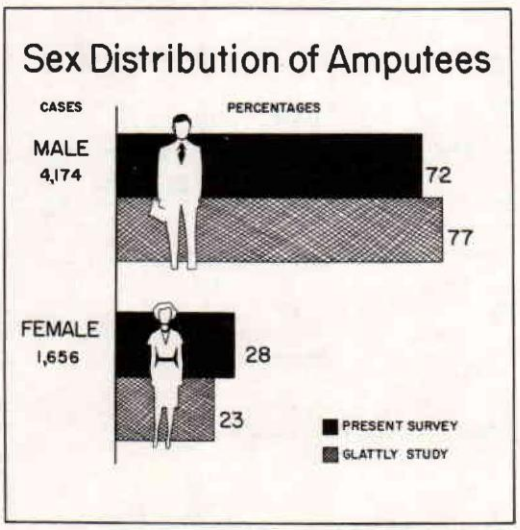
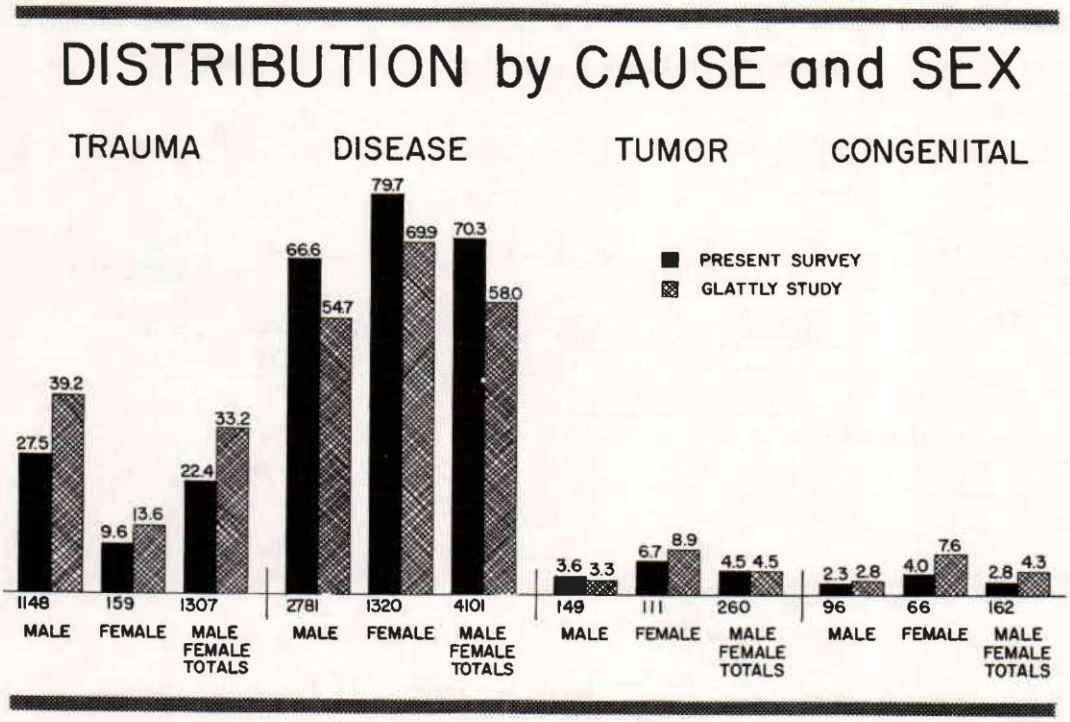


Table 2. Ratios Of Males To Females In Relation To Cause Of Amputation.

	Current Study	*Glattly Study*
Trauma	7.2 to 1	9.2 to 1
Disease	2.1 to 1	2.6 to 1
Tumor	1.3 to 1	1.2 to 1
Congenital	1.5 to 1	1.2 to 1

Distribution of new amputations by cause and sex is considered in somewhat more detail in Table 3. Here, some significant changes have occurred. In the total population (male and female) the percentage of amputations deriving from trauma dropped from Glattly's 33.2 percent to 22.4 percent in the present study, and substan-

Table 3.



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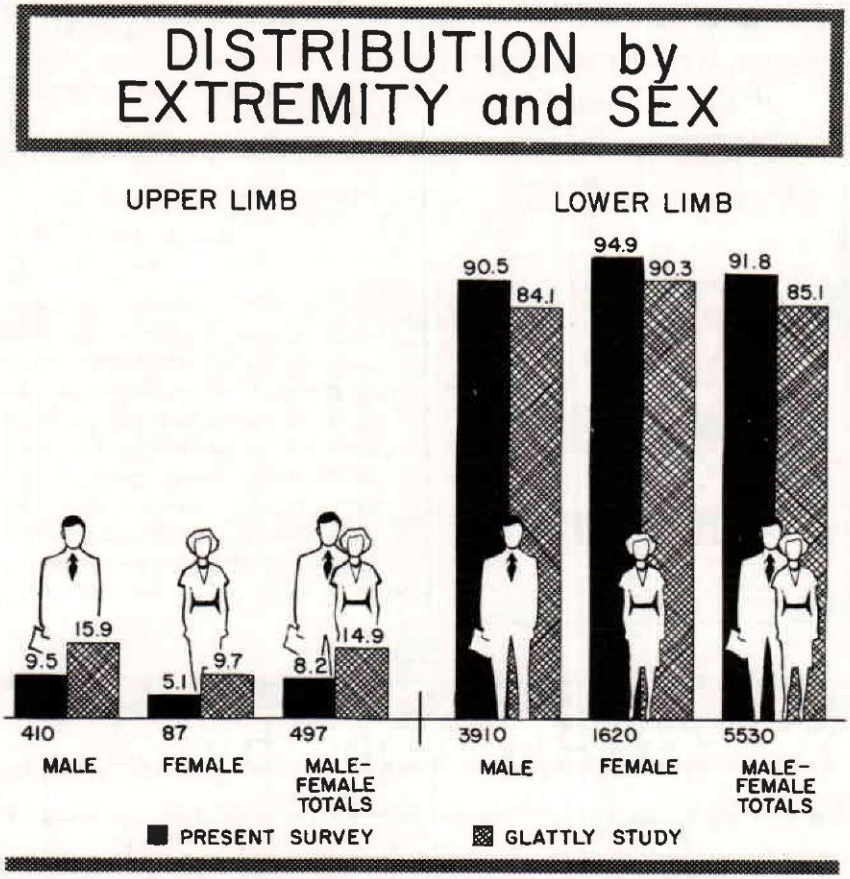


tial decreases in trauma-related amputations in both males and females are apparent. The reverse situation is evident in figures for disease-related amputation. In the total sample the percentage increased from Glattly's 58 percent to 70.3 percent in the present study, percentage increases occurring in both male and female populations. Other cause-of-amputation categories did not appear to show significant changes.

In the 1961-63 study the proportion of lower- to upper-limb amputations in the total sample was roughly 6 to 1 (Table 4). In the present survey the ratio had increased to approximately 11 to 1. This ratio increase was apparent for both males and females. It could be caused by an increase in the number of older patients fitted with lower-limb prostheses rather than a decrease in the incidence of upper-limb amputations.

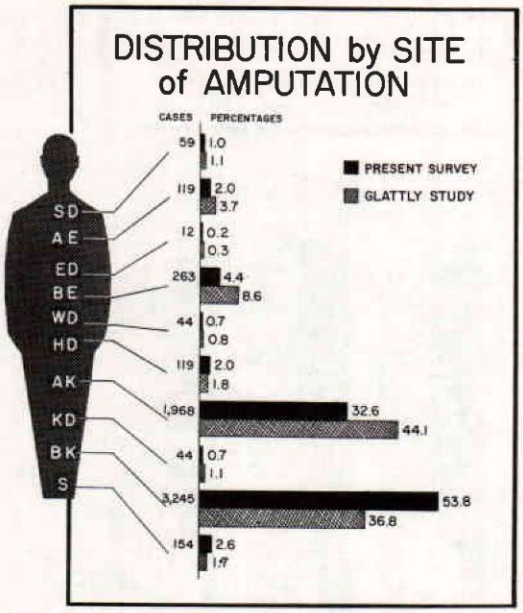
SIDE AND SITE OF AMPUTATION

• *Side*. Glattly found no significant difference in the incidence of left- and right-sided amputations in either the upper or lower limbs. These proportions remained essentially unchanged in the present data (Table 5).

Table 5.
Distribution By Side Of Amputation

	Percent Present Study	*Percent Glattly Study*
Upper Limb		
Left	51.3	49.2
Right	48.7	50.8
Lower Limb		
Left	50.1	49.2
Right	49.9	50.8

Table 6.



• *Site*. The data presented in Table 6 show significant changes in the percentages of above- and below-knee amputations. The present survey shows a decrease to 32.6 percent from Glattly's 44.1 percent in above-knee amputations, and a proportionate increase in below-knee amputations from 36.8 percent to 53.8 percent.

AGE AND CAUSE

Glattly was surprised by the large number of amputees over 70 years of age who were being fitted with prostheses. They numbered 1,749, or 15.4 percent of all reported cases. In the present report the amputees in this category numbered 1,271, or 22 percent of the total number of cases, a significantly higher proportion (Table 7). Moreover, the later data show four more amputees over the age of 91 in a one-year period than there were in the Glattly two-year study (12 versus 8). Both studies revealed that the largest

Table 7.

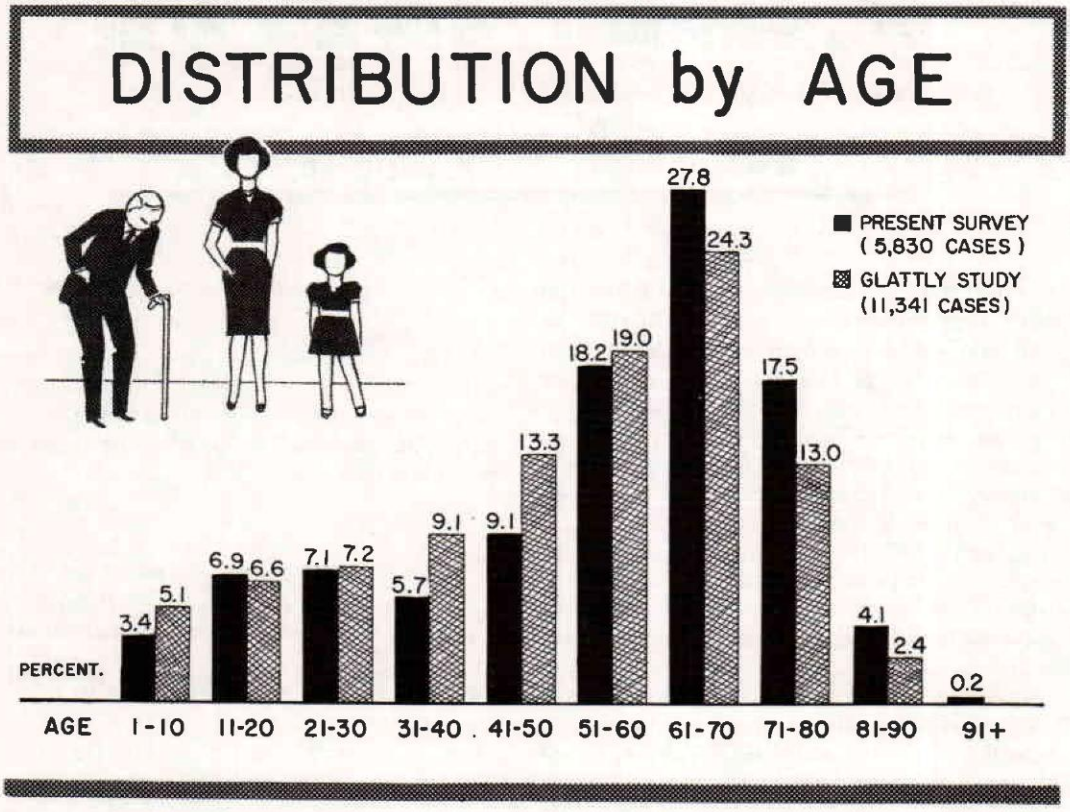
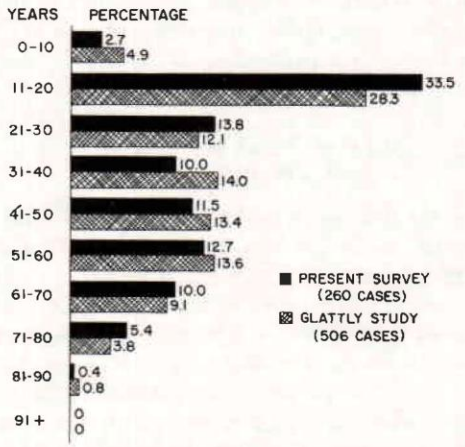


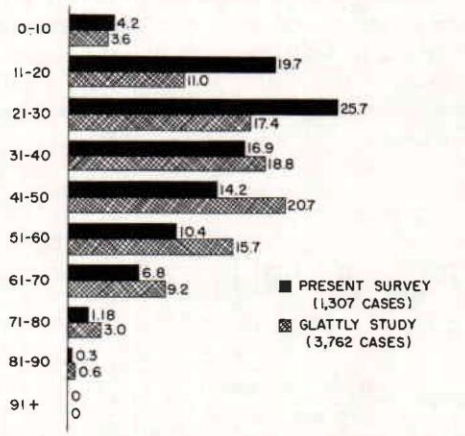
Table 8.

RELATIVE INCIDENCE by AGE

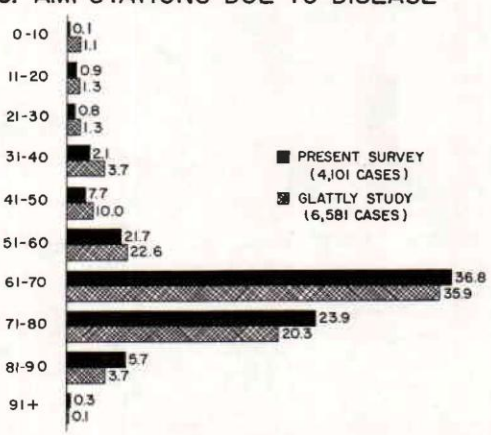
A. AMPUTATIONS DUE TO TUMOR



B. AMPUTATIONS DUE TO TRAUMA



C. AMPUTATIONS DUE TO DISEASE



number of "new" amputees fitted with prostheses were in the 61-70 age group.

• *Tumor.* A relatively high incidence of amputation for malignancy in the second decade of life was noted by Glattly. This common finding was confirmed by the present data (Table 8A).

• *Trauma.* In the Glattly report the largest number of amputations due to trauma occurred in the 41-50 age group. In the current survey the largest number of trauma-related amputations occurred in the 21-30 age group (Table 8B). One might speculate that injuries occurring during the Vietnam war could be largely responsible for trauma-related amputations in the younger age group. However, it seems unlikely that a significant number of such patients could be receiving their first limbs in 1973-74.

• *Disease.* In both studies the largest number of amputations for disease occurred in the 61-70 age group (Table 8C). Ninety-three percent of all amputations in this age group were performed for disease. The figure rises with advancing age — 96.5 percent of amputations for persons over age 71 were for disease.

MULTIPLE AMPUTATIONS

Amputations involving more than one limb that are done at the same time for the same cause are infrequent (Table 9). They represent only 3.3 percent of all amputations in the current study. In Glattly's survey they represented 2.6 percent of all reported cases.

Table 9. Multiple Amputations Occurring At Same Time From Same Cause

	Cases Present Study	Cases Glattly Study
Upper Limb — Same Level	8	32
Upper Limb — Two Levels	2	19
Lower Limb — Same Level	131	96
Lower Limb — Two Levels	38	55
One Upper and One Lower Limb	19	106

POLICY CONSIDERATIONS

The Glattly data provided two items which might influence the policies of State Bureaus of Vocational Rehabilitation:

- *Amputees over 65 years of age who are fitted.* Glattly noted that in six states amputees in this age group exceeded 30 percent of all amputees reported as being fitted in these states. The current study reveals that the 30 percent figure for this group was exceeded in 29 states. In four states the number exceeds 50 percent (Table 10). These data suggest that funds to provide prostheses for the elderly have become more readily available. One could speculate that more are below-knee cases with better chances of success.
- *The percentage of new amputees fitted who are females.* During the period of the Glattly study housewives were not accepted as beneficiaries by certain State Bureaus of Vocational Rehabilitation. In one state females represented only 8 percent of the fitted amputees, but in another they accounted for 36 percent of all new cases. The current study shows that in only two states did females represent fewer than 20 percent of all new amputees fitted (Table 11). Moreover, in 14 states females represented 29 percent or more of the total amputee population, as opposed to only 3 states in this category in the Glattly report. Again, the implication is that funds for fitting female amputees are now available in more states than they were 12 years ago.

BELOW- VS. ABOVE-KNEE AMPUTATIONS

In his discussion of below- and above-knee amputations in patients over 40 years of age, Glattly reported that the vast majority of these individuals had peripheral vascular disease, with or without diabetes. He found "no significant difference in the age distribution of below- and above-knee amputees." No breakdown of his figures showing this distribution is available. Table 12 indicates that in the present CPRD-CPOE-AOPA survey below-knee amputations outnumbered above-knee amputations by a ratio of nearly 2 to 1 for the over-40 age category. However, in the above- and below-knee subsamples, the percentages for each decade were remarkably similar. For instance, of all those pa-

Table 10.

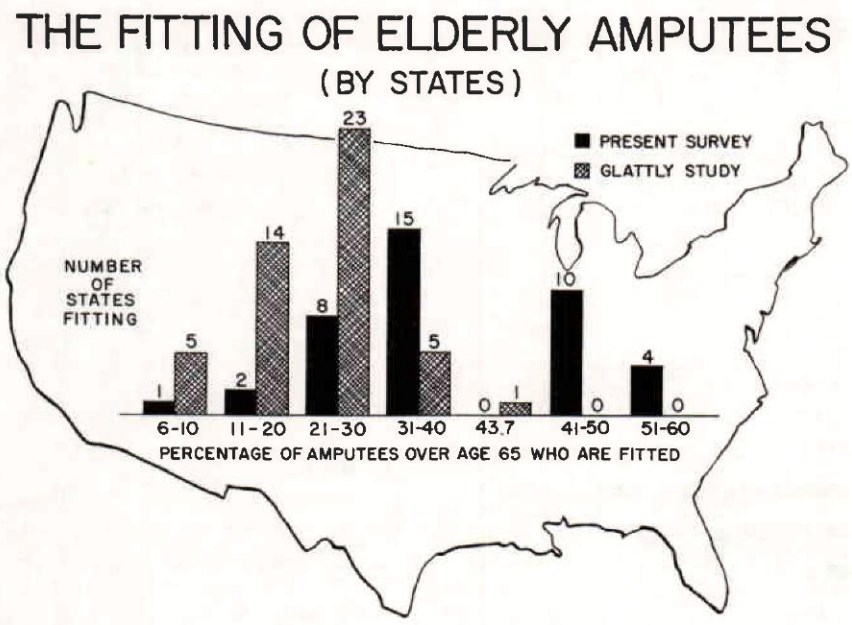
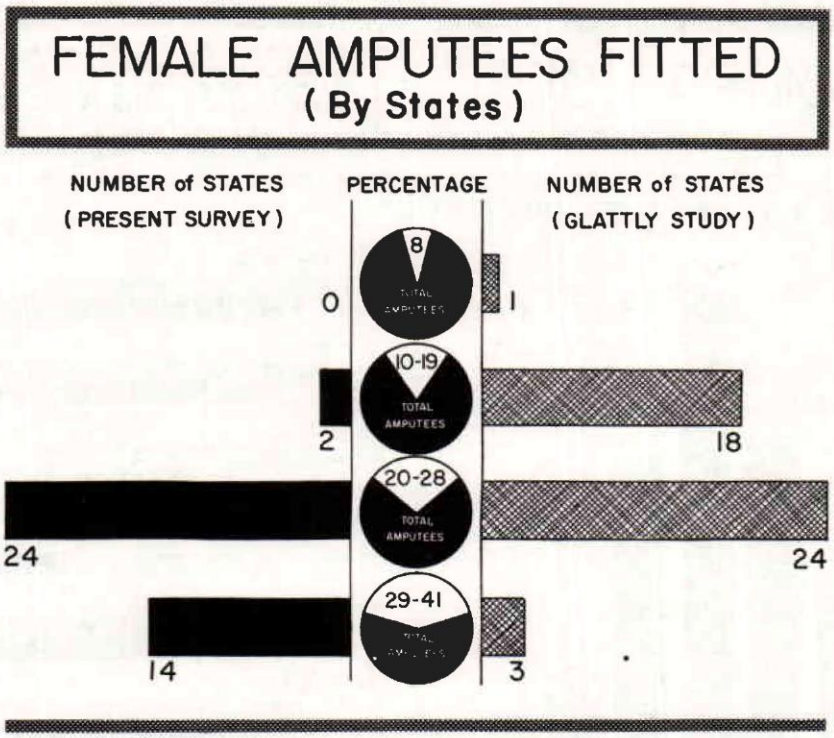


Table 11.



tients receiving above-knee amputations, 9.9 percent fell in the 41-50 year age group; while of all those receiving below-knee amputations, 10.3 percent were in the same age group. This finding suggests that age is not a factor in the decision as to whether the amputation should be above or below the knee.

Glattly cited the then-current textbook warnings against below-knee amputation in cases of gangrene due to vascular disease by reason of the likelihood of a second amputation. However, he reasoned that the relatively large percentage of such amputees who were being successfully fitted at the below-knee level threw doubt upon the validity of this principle. He urged preservation of the knee joint in older individuals, and the current study indicates that more decisions are being made in favor of below- rather than above-knee amputations.

In Table 13 percentages of above- versus below-knee amputations for disease in ten metropolitan areas are shown. Glattly pointed out that, while the patients operated upon were quite similar, 66 percent were amputated at the above-knee level in one area, while in another area only 42 percent were amputated at this level. In the present study, significant changes were found in below- and above-knee rates for the same areas previously reported. In all cities except one (Baltimore), percentages of below-knee amputations for disease increased, with a corresponding decrease in above-knee amputations. Some cities showed quite striking reversals in level selection. San Francisco, for example, showed a 36 to 64 below- to above-knee ratio in the earlier study, but present figures indicate a 74 to 26 below- to above-knee ratio. All cities except one (Philadelphia) showed a higher percentage of below- than above-knee amputations. In four cities (San Francisco, Los Angeles, New York, and Atlanta) below-knee amputations are more than double the reported above-knee amputations. In the Glattly study all but three cities (New York, Atlanta, and Baltimore) reported greater numbers of above- than below-knee amputations for disease.

Table 12.

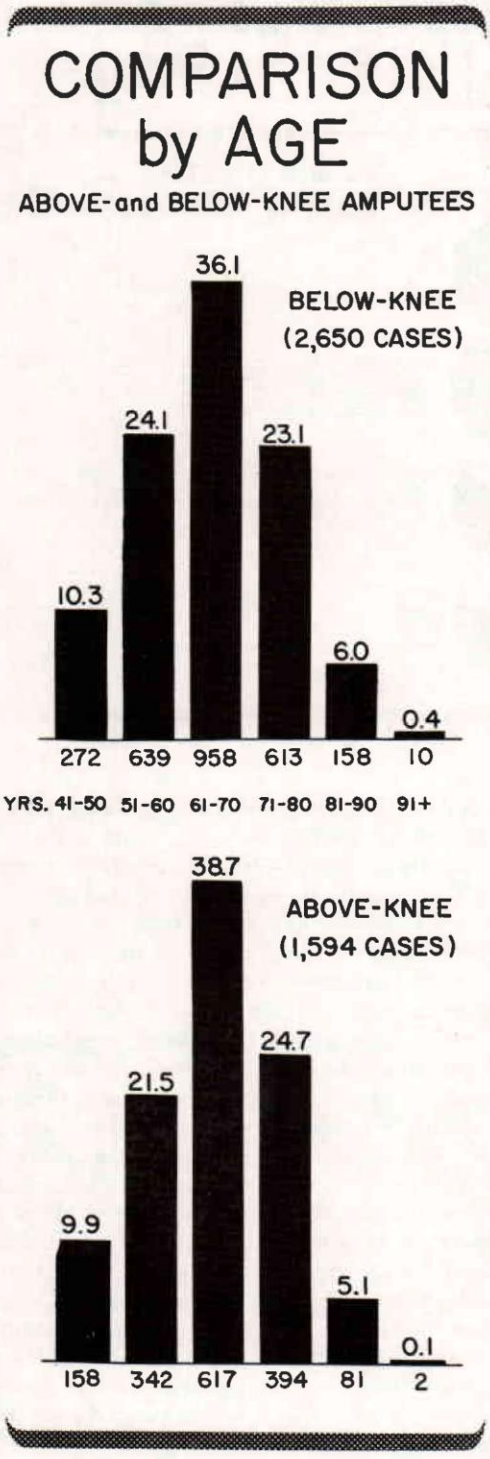
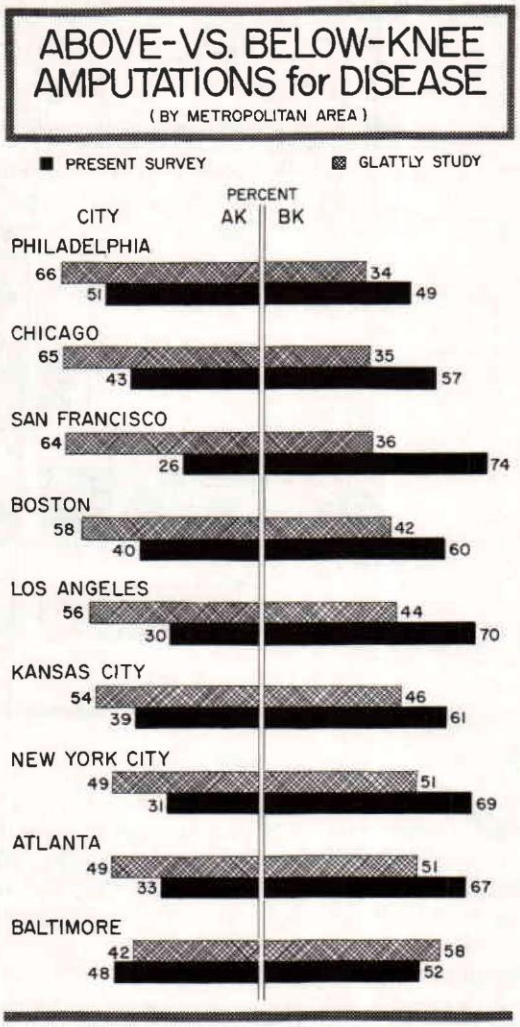


Table 13.



THE SECOND OR THIRD AMPUTATION

Multiple amputations occurring serially in time, reported on data card No. 2 (Fig. 3), made up less than 1 percent of the cases in this study; in Glattly's they represented 1.6 percent of all reported cases. As indicated in the earlier study, the figures do not accurately represent the relative numbers of persons who have had a second or third amputation. Unless such persons were fitted with a prosthesis, they were not included in either study.

For the 56 cases reported on data card No. 2 in this study, the following facts appear significant:

Forty-seven (84 percent) were male amputees.

Forty-one (73 percent) were 50 years of age or over.

Disease was the cause of reamputation in 41 (73 percent) of the cases.

In the 50-and-over age group, disease was the cause of reamputation in 93 percent of the cases.

Trauma accounted for 16 percent; tumor for only 2 percent; and congenital cases, 4 percent.

All but two amputations were of the lower limb. Fifty percent of all lower-limb amputations were at the above-knee level, 30 percent were at the below-knee level.

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ALABAMA

J. E. Hanger, Inc., Birmingham and Montgomery: Lubye M. Paul, Jr.

ALASKA

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ARIZONA

Phoenix Limb Shop, Phoenix: Dale E. Jenkins

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Adams Artificial Limb Company, Little Rock: Cooper C. Collins

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CALIFORNIA

Alpha Orthopedic Appliance Co., Los Angeles: Fred Quisenberry

A-1 Orthopedic Appliances, Inglewood: Patrick Roberts

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- The University of North Carolina Memorial Hospital, Department of Prosthetics and Orthotics, Chapel Hill: J. D. Ferguson, Sara F. Dodson

NORTH DAKOTA
- Fredrickson Orthopedics, Inc., Fargo: Gary Skavlem

OHIO
- American Prosthetic Lab., Inc., Columbus: Peter A. Ockenfels
- Friddle Artificial Limb Co., Toledo: George E. Friddle
- J. E. Hanger Co., Columbus: Denise Mannion
- J. E. Hanger, Inc., Cincinnati: Floyd J. Keeton
- J. F. Rowley Co., Cincinnati: Paul G. Lund
- Shamp Prosthetic Center, Inc., Barberton: Norman E., Daniel L., and N. Joseph Shamp; Marie Reischman
- Shamp Prosthetic Center, Inc., Maple Heights: Elmer Konya

OKLAHOMA

J. E. Hanger, Inc. of Oklahoma, Oklahoma City: Robert E. Collins, Delbert L. Cobb

Lawton Brace & Limb Company, Inc., Lawton: William W. Layton

Minneapolis Artificial Limb Co. of Oklahoma, Oklahoma City: Gordon Johnson

Sabolich, Inc., Oklahoma City: Lester J. Sabolich, B. Ray Buddin

OREGON

Coast Orthopedic Co., Portland: Ray Moore

PENNSYLVANIA

Boas Surgical, Inc., Allentown: Ernest S. Boas

J. E. Hanger of Philadelphia, Inc., Philadelphia: Frances T. Lukas

J. C. Lloyd Artificial Limb Company, York: Kathleen Lloyd

U.S. Navy Hospital, Prosthetics & Orthotics, Philadelphia: F. J. Cremona

Scranton Artificial Limb Company, Scranton: Herbert E. Niehuus

Eugene Teufel & Son Orthotics & Prosthetics, Inc., Elizabethtown: Robert G. Florschutz

Union Artificial Limb & Brace Co., Inc., Pittsburgh: Leonard A. Svetz, Catherine Keane

Zielke Orthotics & Prosthetics, Inc., Lancaster: Donald G. Zielke, Barbara Falk

TENNESSEE

Bonds Prosthetics & Orthotics Co., Division of Fillauer Orthopedic, Inc., Knoxville: James M. Bonds

J. E. Dillard Co., Nashville: John E. Dillard, Betty Arkley

Fillauer Orthopedic, Inc., Chattanooga: Karl Fillauer

Fillauer Surgical Supplies, Inc., Johnson City

Snell's, Inc., Nashville: L. D. Lane, Jr.

Snell's of Jackson, Inc., Jackson: Robert G. Coleman

Snell's Limbs & Braces, Inc., Memphis: Suzanne Abraham

Tri-State Limb & Brace Co., Inc., Memphis: Floyd D. Simmons

TEXAS

Austin Prosthetics Center, Austin: Dennis Cole

Galveston Brace & Limb Co., Galveston: Dan Morgan

J. E. Hanger, Inc. of Texas, Dallas: Robert F. Reich

Rupley Artificial Limb Co., Fort Worth: Alvin E. Rupley

UTAH

University of Utah Medical Center, Arthritis Project, Salt Lake City: Earl V. Shields, Ronald L. Webb

VIRGINIA

J. E. Hanger, Inc. of Virginia, Richmond: Arthur R. Collins; Roanoke: Ralph T. Coffman

Tidewater Prosthetic Center, Inc., Norfolk: Raymond Francis

University of Virginia Medical Center, Division of Prosthetics & Orthotics, Orthopedics & Rehabilitation, Charlottesville: Virgil Faulkner

WASHINGTON

American Artificial Limb Co., Seattle: Joseph H. Zettl, Ilse Kunkel

Prosthetics Research Study, Seattle: Shirley M. Forsgren, Anne G. Alexander

Schindler's, Inc., Spokane: Alton W. Christenson

Tacoma Brace & Limb Co., Tacoma: Loren R. Ceder

University of Washington, Department of Rehabilitation Medicine, Seattle: Bernard C. Simons

WEST VIRGINIA

J. E. Hanger, Inc. of West Virginia, Charleston: James A. Swimm

WISCONSIN

Acme Surgical Appliance, Inc., Milwaukee: David C. Schultz

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