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A-636714

USAMBRL
TECHNICAL REPORT 6609

INSTRUCTION MANUAL FOR PREPARING A POROUS
EPOXY PTB SOCKET WITH SOFT DISTAL END

Reported by: Robert E. Plumb, C. P.
James T. Hill, Chem. Eng.
Henry Mouhot, Chem. Eng.

May 1966

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Project: 3A025601A821 01 095

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ABSTRACT

A simplified procedure for preparing PTB sockets is described. Preimpregnation of the stockinet and evaporation of solvent prior to lay-up results in a stronger, more porous socket.

INTRODUCTION

A prior report ^{*} of this laboratory described a technique for preparing a porous patella-tendon-bearing below-knee socket with a soft distal end. Since this report was written a new method of making porous laminates has been developed.

By this method it is possible to make laminates two and a half times stronger and twice as porous as the older method, utilizing a simpler and more reproducible procedure.

The adaptation of this method to the preparation of porous patella-tendon-bearing below-knee sockets with a soft distal end is described.

LAMINATING PROCEDURES

(1) Examine the patient's stump for bony prominences and tender areas, and outline these areas with an indelible pencil.

(2) Sew one end of a 12-inch length of 3-inch orthopedic stockinet and fit it over the patient's stump well above the knee cap.

(3) With the stump held in 15° flexion, wrap the stump with 3 rolls of plaster of Paris bandage, starting from the middle of the stump and spiralling down and up the stump from the distal end to above the patella.

(4) Smooth the wrap by massaging with the hands and working the plaster around the bony prominences.

(5) As the plaster begins to harden, place the thumbs on each side of the patella-tendon and the finger pads in the popliteal areas, with the upper fingers at the level of the posterior curve of the knee.

(6) Use firm finger and thumb pressure until the plaster has hardened completely.

*USAMBRL TR 6311, "Patella-Tendon-Bearing Below-Knee Porous Socket with Soft Silastic Distal End," June 1963.

(7) When the plaster has hardened, release the finger pressure but allow the wrap to remain on the stump an additional minute or two.

(8) Carefully remove the wrap and fill the cast with plaster of Paris.

(9) Drill a 1/4" hole in a pipe near one end; insert the pipe inside a paper cup through the bottom of the cup, slide the cup up until the 1/4" hole is inside the cup. This is for later use with the vacuum system.

(10) Insert the pipe into the plaster of Paris until the top of the paper cup is flush with the plaster.

(11) After the plaster has set, remove wrapped cast.

(12) Apply plaster to build-up in the required areas which have been outlined with indelible pencil.

(13) Trim and smooth mold as required.

(14) Apply 3 coats of Hi-Glo parting lacquer, drying after each coat.

(15) Moisten a PVA sheet in a damp towel; pull down over the model and make certain that sheet is wrinkle free.

(16) Tie PVA sheet off at the pipe.

(17) Apply a vacuum of 12 in. Hg. to the system to pull the PVA against the mold.

(18) Cut one piece of nylon Banlon and 5 pieces of nylon orthopedic stockinet about 6 inches longer than model. Turn the Banlon stockinet inside out. Sew one end of each piece to correspond with the distal end of the stump model. Trim sewn end. Next, **WEIGH ALL STOCKINET TO NEAREST GRAM.**

(19) Pull one layer of Banlon stockinet and one layer of orthopedic stockinet down over the layup and tie off at pipe.



Figure 1

(20) Outline on the stockinet the area to be impregnated with silicone rubber using masking tape around the circumference to keep the excess rubber out of the remaining cloth (Fig. 1). This area is defined as that portion of the distal stump where the slope of the stump borders start to change sharply to the distal end.

(21) Mix Silastic RTV 502 Silicone Rubber (25 g) and 2 drops of catalyst and thoroughly impregnate the outlined area to 1/4" distal to the mark.



Figure 2

(22) Stretch a moistened PVA sheet over the impregnated area and tie it off. (Fig. 2)

(23) With the fingers, spread and burnish the silicone rubber into the stockinet to the mark and permit the silicone rubber to cure. Remove the PVA bag.



Figure 3

(24) Position a piece of Mylar sheeting around the distal end of layup at the proximal edge of the silicone rubber and extending about 3-4 in. beyond the tip of stump model (Fig. 3).

(25) Tape the contact area of the Mylar to the socket wall with masking tape.



Figure 4

(26) Mix the following formula: Silastic 5370-19 g., Silicone Rubber 502-31 g., Catalyst 5370-3 g., and pour into the open end of the Mylar cylinder (Fig. 4).

(27) Introduce sufficient foaming material to allow its expansion 1 inch distal to the end of model.

(28) After 5 minutes remove the Mylar supporting wall.



Figure 5

(29) Contour foam so there is about 1 inch of foam covering silicone area (Fig. 5). Make an alignment mark on foam so it can be later realigned. Remove foam tipped stockinet from model.

(30) Pull a disposable glove over the foam tip just to the edge of the silicone. This will protect the foam from getting impregnated with resin in a subsequent step. Pull the orthopedic stockinet back over the covered foam tip.

(31) Take these foam tipped pieces and roll loosely. Roll the 4 remaining pieces of orthopedic stockinet. Place all stockinets into a 12" x 16" polyethylene bag.

(32) Mixing Resin: Referring to Table I, go down the first column until you come to the weight of the stockinet. The amount of resin components will be found directly to the right in the next 3 columns. For example: Stockinet weight = 100 g; then directly to the right under the column headed EPON 815, you will find a weight of 129 g. Under column headed VERSAMID 140, you find 34 g, and under METHYLENE CHLORIDE column, you find 172 g. These are the amounts of each ingredient that should be mixed together for the 100 g. of stockinet. Add pigment.

(33) Pour all the resin mixture into the bag onto the stockinet. Impregnate the stockinet by kneading. Spread stockinet in bag to see if all pieces are uniformly impregnated. If some areas are void of resin, squeeze resin into these areas from other parts of the stockinet.

(34) Place pieces of stockinet side by side on paper towels and put into a circulating air oven set at 95 C (203 F) for exactly 5 minutes.

(35) Remove from oven. Wipe silicone coated stockinet with a piece of gauze to remove any resin. Remove disposable glove from foam tip.



Figure 6

(36) Pull foam tipped stockinet over layup, align, and tie to pipe. Next, pull two pieces of the remaining orthopedic stockinet over the layup and tie. (Fig. 6.)

(37) Wrap a piece of masking tape around the layup about 1 inch proximal of the edge of the foam-silicone edge. Tape some paper towels around the layup to protect the stockinet proximal to this foam-silicone edge.

(38) Brush coat the distal tip with Shell EPON 815 - 4 parts and Shell Curing Agent T 1 - 1 part. After tip is thoroughly impregnated, wrap a 1-inch wide strip of PVA around just at the distal edge of the masking tape. This will insure a firm bond at the laminate-silicone boundary. Use a heat gun to cure tip (3-5 minutes).

(39) After tip has set up, turn remaining two pieces of stockinet inside out and pull over layup and tie at pipe.

(40) Apply a PVA sleeve to the layup. Pierce the inner bag with an awl and tie the outer sleeve at both ends.

(41) Place under a vacuum of 12 in. Hg. Apply a heat gun to set up the under-cut areas. When these areas have set, place layup in an oven for 1-1/2 hour at 95 C. (This step can be carried out in one operation if a hose is run into the oven for connection of the vacuum pump to the laminate).

(42) Remove the outer PVA bag and trim the laminate at the proximal end and remove the plaster model from the socket. Glue a 3/4" thick piece of wood 4-1/2" in diameter to bottom of socket for attaching to the adjustable leg.

(43) Attach the socket and foot to the adjustable leg to obtain correct alignment.

(44) Place the plaster model back into the socket, and place the entire assembly into the duplicating jig and duplicate in accordance with standard practice.

(45) Remove the complete setup from duplicating jig, making temporary spot glue joints; attach the two pieces together, keeping the correct alignment.

(46) Shape ankle section and fair into the wood base at the base of the socket.

(47) Make identifying marks on the ankle section and the wood base section.

(48) Hollow out the ankle section for lightness.

(49) Place socket on the ankle section, keeping all marks aligned.

(50) With the plaster mold in the socket pull a PVA sleeve down over the below-knee socket and secure on the distal end.

(51) Fashion a Mylar cylinder and attach to the wood base at the distal end of the socket; extend up to the patella-tendon impression on the socket.

(52) Melt A. C. Polyethylene grade 629 at 125 C and pour into the top of Mylar cylinder and allow to harden.

(53) Remove the Mylar and glue the ankle and socket sections together temporarily. Shape the polyethylene according to the desired contours and shape and smooth the complete assembly.

(54) After shaping, separate the two sections and pull the PVA sleeve down over the socket and cover the polyethylene, making sure the PVA sleeve also covers the base of socket and the wooden glue plate.

(55) Punch through the PVA bag with an awl at one of the two holes in the plaster model and attach to the ankle section. Tie PVA off at pipe.

(56) Cut three layers of nylon orthopedic stockinet and one layer of nylon Banlon stockinet; weigh all stockinet; then, roll and place them into a polyethylene bag.

(57) Referring to Table I (see Step 32), determine the correct amounts of resin components and solvent (methylene chloride). Weigh out these components, add pigment, mix, and pour into the polyethylene bag onto the stockinet. Knead the resin into the stockinet.

(58) Spread the stockinet in the bag to see if all pieces are uniformly impregnated.

(59) Spread impregnated pieces of stockinet on paper towels and place into the oven for exactly 5 minutes at 95 C.

(60) Remove stockinet from the oven and pull over layup with the Banlon on the outside.

(61) Start vacuum pump and pull a PVA sleeve over entire layup. Tie off both ends and adjust the vacuum to 12 in. Hg.

(62) Use a heat gun to set up the laminate at the patella.

(63) When the undercut at the patella has set, shut off the vacuum and place laminate into an oven set at 95 C. for two hours.

(64) Remove laminate from the oven, strip away the PVA, trim the proximal end and remove the plaster mold and inner socket. Break away the polyethylene and remove the PVA from the inner socket.

(65) Apply glue to the wooden block at the distal end of the socket and insert the socket into the laminated shank.

(66) Trim and finish socket in usual manner, bonding the two laminated edges together at brim using EPON 815 - 4 parts and Curing Agent T 1-1 part.

TABLE I

Weight of Resin Components necessary for making porous prostheses

VT. STOCKINET GRAMS	WEIGHT OF RESIN COMPONENTS		
	EPON 815	VERSAMID 140	METHYLENE CHLORIDE
25	36	18	48
30	42	21	56
35	49	24	65
40	55	27	73
45	61	30	81
50	66	33	88
55	73	36	97
60	78	39	104
65	84	42	112
70	90	45	120
75	96	48	128
80	103	51	137
85	109	54	145
90	116	58	154
95	122	61	163
100	129	64	172
105	135	67	180
110	141	71	188
115	148	74	197
120	154	77	205
125	161	80	213
130	167	83	222
135	173	87	231
140	180	90	240

(Continued)

TABLE I

VT. STOCKINET GRAMS	WEIGHT OF RESIN COMPONENTS		
	EPON 815	VERSAMID 140	METHYLENE CHLORIDE
150	193	96	258
160	206	103	275
170	218	109	291
180	232	116	309
190	244	122	325
200	257	129	343
210	270	135	360
220	283	141	377
230	296	148	395
240	308	154	412
250	321	160	428
260	334	167	445
270	347	173	463
280	360	180	480
300	385	193	514
320	411	206	547
340	437	218	582
360	463	231	617
380	488	244	652
400	514	257	685
420	540	270	720
440	565	283	755
460	592	296	789
480	617	309	822
500	643	322	857

LAMINATING MATERIALS

EPON 815 Curing Agent T 1	Shell Chemical Co. 380 Madison Avenue New York, N. Y.
VERSAMID 140	General Mills Chem. Div. Kankakee, Ill.
Methylene Chloride	Any Chemical Supply House
Banlon Stockinet	Bell Horn 451 N. Third St. Philadelphia, Pennsylvania 19123
Hi-Glo	Western States Lacquer Co. Dallas, Texas
PVA	Reynolds Metal Company Richmond, Virginia
Silastic RTV S-5370	Dow Corning Corp. Midland, Michigan
Silicone Rubber 502	" " "
A. C. Polyethylene Wax Grade 629	Semet Solvay Products Allied Chemical & Dye Corp. New York, New York
Mylar	E. I. DuPont de Nemours Film Division Wilmington, Delaware
Disposable Gloves	Bard-Parker Co., Inc. Rutherford, New Jersey
Polyethylene Bags - 2 mls.	Any Chemical Supply House

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Security Classification

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1. ORIGINATING ACTIVITY (Corporate author) U. S. Army Medical Biomechanical Rsch Lab. WRAMC, Forest Glen Section		2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	
		2b. GROUP	
3. REPORT TITLE INSTRUCTION MANUAL FOR PREPARING A POROUS EPOXY PTB SOCKET WITH SOFT DISTAL END			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (Last name, first name, initial) Robert E. Plumb, C. P. James T. Hill, Chem. Eng. Henry Mouhot, Chem. Eng.			
6. REPORT DATE May 1966		7a. TOTAL NO. OF PAGES 12	7b. NO. OF REFS None
8a. CONTRACT OR GRANT NO. a. PROJECT NO. 3A025601A821 01 095 c. d.		8a. ORIGINATOR'S REPORT NUMBER(S) Technical Report 6609 8b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
10. AVAILABILITY/LIMITATION NOTICES			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY	
13. ABSTRACT A simplified procedure for preparing PTB sockets is described. Preimpregnation of the stockinet and evaporation of solvent prior to lay- up results in a stronger, more porous socket.			

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
1) porous prostheses 2) artificial limbs 3) plastic socket						

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