MANUFACTURING TECHNIQUE FOR SILICONE SOCKETS FOR HIP DISARTICULATION AND HEMIPELVECTOMY PATIENTS.

Steve Taylor (Prosthetic Clinical Specialist)
RSL/Steeper Ltd., Nottingham Mobility Centre UK
Email: staylor773@aol.com or
Prosthetists.nottingham@rehab.co.uk

1st STAGE LAMINATE ACRYLIC FRAME: Seal the cast with sealing resin, apply a PVA bag and then 4 layers of PERLON to cast (note these 4 layers of PERLON are to make allowance for the inner layers of silicone which is done in stage two of the manufacturing procedure (see 2nd stage of laminating procedure) and will be used later in the manufacture process. Apply a PVA bag over the PERLON. Apply lay up for hip joint mounting plate reinforcement, this lay up will depend on which manufacturers hip joint is being used and to local procedures, patient weight etc. Then apply the outer PVA bag. Laminate with rigid and flexible acrylic resin as required depending on the desired flexibility (the same method as you would use to make an Otto Bock rigid/flexible acrylic socket). The author has found that rigid resin is required around the hip joint mounting plate only. Once the resins have gone off, cut off the acrylic frame and reduce to the size required. The author has found that with young active patients combined with Ischial Containment that the frame can be kept to the amputated side of the socket only, less active patients may require the flexible frame to be extended to the contra lateral side. Taper the edges of the frame off and rough up the inside and outside surfaces. Put the frame to one side for use later. Retain the 4 layers of PERLON on the cast.

The size of the acrylic frame depends on how flexible the individual patient requires the socket to be. (See pictures below for examples).

Fig 1.

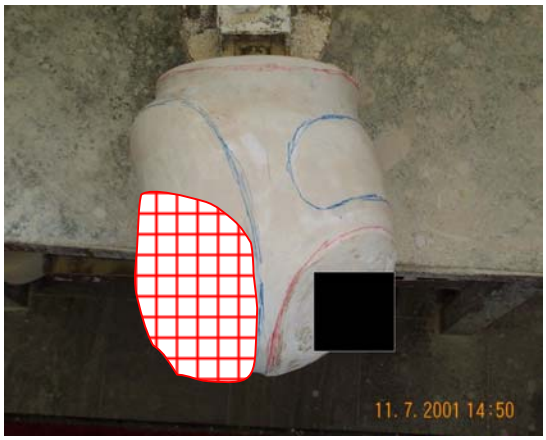

Fig 2.

The first patient shown in Figs 1 and 2 required extra support to contra lateral side, so the flexible acrylic frame, represented by blue area continues around to the contra lateral side, as can be seen. The red lines indicate silicone trim line and he red cross hatch area the rigid acrylic laminate.

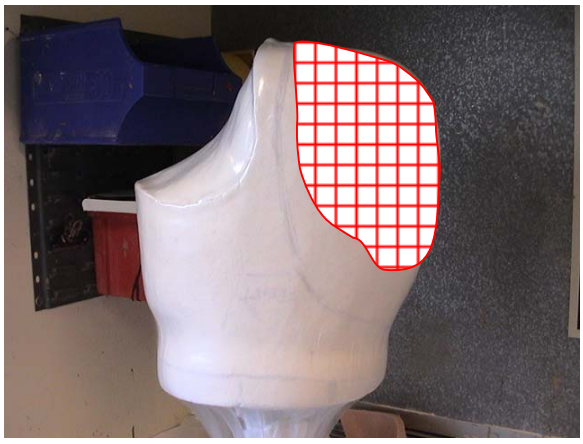

Fig 3.

Fig 4.

Fig 3 shows a second patient that required less support than the first patient, so the rigid/flexible acrylic frame is only required around the amputated side as indicated by the blue line. The red cross hatch area again represents the extent of the rigid part of the acrylic frame. Fig 4 shows the Otto Bock hip plate aligned on the cast.

Steve Taylor (Prosthetic Clinical Specialist)
Staylor773@aol.com
Issue 3.

Fig 5.

Fig 5 shows the 1st laminating stage completed with the acrylic flexible/rigid frame laminated for second patient.

2nd STAGE LAMINATE INNER SILICONE: (***Note for the next two silicone lamination stages to be successful they must be done on the same day***). Apply a new outer PVA bag over the existing 4 new layers of PERLON. Mix up half the required IPOCON 7 parts A silicone and then B curing agent (see instructions on containers). We have found that an average hip disarticulation cast requires about ¾ of a tub of part A and about ½ a bottle of part B. A very large hip disarticulation or hemipelvectomy requires a whole tub of part A and ¾ of a bottle of part B. The basic part B curing agent gives a curing time of 2 hours. There is another part B curing agent (B quick) that gives a curing time of ½ an hour. This is too quick for the inexperienced but we have found mixing the two curing agents standard and quick gives a curing time of 1 hour, which is about the time required to do this stage comfortably. It must be noted that you have to work the silicone through the PERLON, as it is too viscous to come through under suction alone. With experience it is possible to do this in ½ an hour so IPOCON 7 B quick can be used.

Fig 6.

Fig 6 shows tub of IPOCON 7 part A and bottle of curing agent part B.

Fig 7.

Fig 7 shows the 4 ply inner silicone laminate.

Part numbers of materials: NF 040779 - Component A (silicone)
NF 040780 - Component B (curing agent)
NF 040781 - Component B quick (fast curing agent)
NF 001937 – Body paste

Note: *We have not used the body paste yet this is for padding sensitive areas and major depressions.*

3rd Stage LAMINATE OUTER SILICONE: Mix sufficient silicone resin for an additional lamination. Remove the outer PVA bag from cast when the laminated silicone from the first stage has cured but is still tacky. Brush the flexible acrylic frame with laminating silicone and position the frame on cast. Now lay up for the outer silicone. Lay up two layers of PERLON and insert two pieces of 2" wide cotton webbing for the corset eyelets and a 2" webbing reinforcing strap around the waist to control stretching of PERLON circumferentially. Apply a piece of polyethylene (plastic) to serve as a separator for the tongue at the front, as per Otto Bock technique. Then lay up a further two layers of PERLON. Pull on an outer PVA bag and laminate with silicone resin.

Note*: This method only works if the process is done on the same day whilst the first silicone lamination is still tacky.* If the inner and outer silicones layers are not done on the same day, they will not stick together. It is still possible to get round this problem if

you rough up the inner silicone and then apply IPOS silicone adhesive. Apply a layer of PERLON apply silicone adhesive and allow this to get tacky before doing the outer silicone stage. We have found that a corset-type closure is preferable to straps as the straps reduce the flexibility of the front of the socket to some extent.

Fig 8.

Fig 9.

Fig 8. and Fig 9. Show the 3rd laminating stage. These show the second patient's cast laid up ready for the outer silicone lamination. It can be seen that this patient only has an acrylic frame to the amputated side and this is how we are doing most our sockets now. Reinforcement webbing for the corset eyelets can be seen. The webbing is not easily impregnated with silicone so we are now trying other laminating materials for reinforcement and Kevlar seems to work well. Recently we have done the complete silicone stage in one operation. Holes are drilled through the frame to aid penetration of the silicone and this has been successful.

Note: *These are not definitive laminating procedures: just what we have done so far. On the next page are some pictures of the end results.*

Steve Taylor (Prosthetic Clinical Specialist)
Staylor773@aol.com

Fig 10.

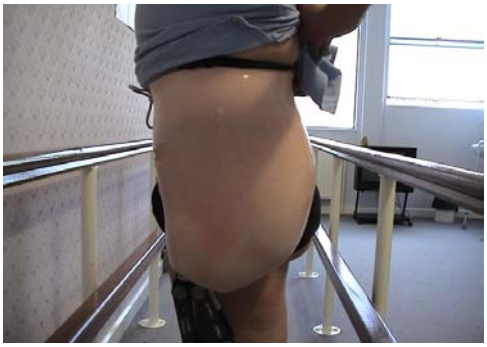

Fig 11.

Fig 10 and Fig 11 show the first patients finished socket with a corset type suspension. Bolt-through style hip joints [e.g. Endolite] make the manufacture more complicated and the socket not so cosmetic internally as you have to cut an access panel in the silicone.

Fig 12.

Fig 13.

These two pictures Fig 12 and Fig 13 show our first ever attempt. We did not do the inner and outer silicone on the same day and this resulted in the inner and outer not adhering very well. We had to use silicone adhesive to glue the two together. You can see that we used VELCRO straps for suspension, this was found to inhibit the flexibility of the silicone and we would now recommend a corset suspension.

Steve Taylor (Prosthetic Clinical Specialist)
Staylor773@aol.com

Many Thanks should be given to Technicians Paul Gamble and Paul Metthan for their efforts in the refinement of this technique. Thanks should also be given to the Bloorview Macmillian centre in Canada who kindly provided their manufacturing procedure, from which we developed this approach. Thanks should also be given to Tony Van der Waarde who has been a leading advocate for silicone sockets for these patients. Finally, grateful appreciation is given to Christina Skoski for the encouragement to pursue this project, for advice on obtaining additional technical information, and for the excellent resources on her web site [**www.hdhphelp.org**].

References:

1. Van der Waarde, T. Ottawa Experience with Hip Disarticulation Prostheses. Orthotics and Prosthetics, Volume 38, Number 1, spring, 1984, pp. 29-35. The American Orthotic and Prosthetic Association.
2. Van der Waarde/John Michael, Hip Disarticulation Management, Chapter from, ATLAS OF LIMB PROSTHETICS: SURGICAL, PROSTHETIC, AND REHABILITATION PRINCIPLES, second edition. Edited by John. H.Bowker and John Michael for the American Academy of Orthopaedic Surgeons. Published by Mosby- Year Book, Inc., 1992

Steve Taylor (Prosthetic Clinical Specialist)
Staylor773@aol.com