



The Multiple Uses of Processed Tung Oil in Industrial Surgery

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TUNG OIL, or China wood oil, as it is known in China, the country of its origin, whence its culture and production have spread to this country and elsewhere, is the product obtained from the dried fruit or (nuts) of the tung tree, which belongs to the family of the Euphorbiaceae, or spurge, and to the genus *Aleurites*, of which there are three distinct species—*Fordii*, *Montana*, and *Cordata*. The oil's use is most popularly known industrially, in the manufacture of high grade paints and varnishes, as one of the fastest drying and most penetrating of the so-called drying oils.

Although tung oil has been widely used in China for medicinal purposes, it seems to have been almost completely ignored by modern pharmacists who only lately have begun turning increasingly interested eyes toward the ancient Chinese *materia medica* for helpful hints that have already led to discovery of several of our newer and more popular modern drugs.

The tung oil used in the cases cited in this paper was pure American tung oil, specially processed to render it sterile as well as to permit medical use of the raw oil. (This process prevents an isomerization reaction which usually occurs when raw tung oil is exposed to light and which causes the raw oil to change its molecular structure and take on a solid form that renders the oil unsuitable for administration and not nearly as satisfactory from a healing standpoint. The process differs from ordinary polymerization methods in that its resultant product is not thickened or discolored but retains all the qualities and appearance of raw tung oil).¹

American tung oil is expressed from nuts of trees of the *Fordii* species, which is the common type tree planted in the Deep South in an area which extends approximately 80 to 100 miles inland from the coast of the Gulf of Mexico, from the extreme eastern portion of Texas across northern Florida. The oil is clear light yellow or golden in color and of a consistency slightly thinner than pure honey, with a characteristic odor.

A thorough study of the history of this remarkable material now making its debut into

American medicine reveals the interesting fact that the U. S. Pure Food and Drug Administration has ruled that tung oil is an old drug, although the medical history of tung oil—as far as American medical literature is concerned—seems confined to only a very brief mention in the U. S. Dispensatory and a description of the hypertension-reducing activity of tung oil as reported by Dr. Arthur Grollman in the *Journal of Pharmacology and Experimental Therapeutics*.² Such a general study also reveals definite reason for modern medicine's lack of interest and virtual omission of this material from its use as well as its literature.

Two early references to a toxic effect attributed to tung oil,³ both of which have been widely repeated throughout tung oil literature, probably account for our modern pharmacopoeia's omission of tung oil as a useful medicinal agent. Hertkorn⁴ in 1903 described an effort made by two German chemists to introduce tung oil into the European pharmacologie, but reported that his use of an ointment they prepared had resulted in severe ulcerations and dermatitis. Much later, M. W. Swaney, of the Ellis Laboratories, of Montclair, N. J., wrote a lengthy paper describing a "severe case of dermatitis" attributed to tung oil as contracted by a worker in the Montclair plant.⁵

What is important to note is that both of these authorities report on tung oil which had been shipped out of China for use in the paint and varnish trade. Hertkorn describing a tung oil product made in Europe from such imported oil and Swaney telling of an oil which he, himself, describes as "dark in color and probably of Chinese origin." The list of adulterants commonly used in tung oil exported from China for industrial purposes is long and varied. But most significant is this statement regarding the effects of such adulterants and regarding tung oil's alleged toxicity by a noted tung oil expert, James Claude Thomson, American-educated and for more than 20 years professor of chemistry in China's University of Nanking, whose chemistry department he headed in later years. In a lengthy study of tung oil prepared for a Ph.D. thesis at Columbia University and presented after almost

15 years of residence, study and teaching in China, Thomson writes:

" . . . Although it is often stated that the fresh wood oils are poisonous, producing severe rashes and eruptions when in contact with the skin, this has not been the experience of the author, who has expressed many samples of the oils from all three species of *Aleurites* in the Chemistry Laboratories of the University of Nanking, Nanking, China, without experiencing the slightest poisonous or toxic effects, even though the warm fresh oil as well as the steaming ground meal was in contact with his hands on many occasions. The poisonous effects experienced by others may have been due to the presence of Chinese lacquer, produced from the poisonous sumac, which is often added to the expressed wood oils for special purposes. The slightest contact with this fresh lacquer generally produces rashes and skin eruptions similar to those produced by the common poison ivy of America."

Mr. Thomson also describes experiments conducted at Columbia University in which Chinese wood oil was added to the diet of white rats to the extent of 10 per cent of the ration without the production of any signs of toxicity.⁷ Experiments conducted on 15 dogs at Tulane University demonstrated that the degree of toxicity in tung oil, even when administered internally, is so slight that an LD-50 could hardly be found.⁸ In 140 patch tests made on human skin not a single case of allergic reaction to a specially processed American tung oil was demonstrated, and in my own practice I have not observed any such reaction.⁹

It is interesting in this connection to observe that the Chinese *materia medica*, in an extended account of the uses to which Chinese medicine has put tung oil, notes that the Chinese, themselves, apparently differentiate between types of the oil, even in their own country with the observation that "the best wood oil comes to Hankow from Shin-Chau Fu, in Hunan." It is also interesting to note that practically without exception, all authorities on tung oil state repeatedly and categorically that tung oil has long been employed in soap making, a use to which it could not be put if the so-called toxic effects so often erroneously attributed to it were founded on fact.

The complete absence of reports on any infection or irritation among workers in Chinese or American tung orchards or mills is further evidence that medical science, through an unfortun-

ate error, has failed to develop the potentialities of an important material for alleviating pain and discomfort of some of our most common ills or possibly curing many even more serious ones.

DISCUSSION

And now that every effort has been made to show that processed tung oil is nontoxic, we will render a report on its use in industrial surgery.

For the past nine months, we have used processed tung oil on all of our injuries, and also in elective minor surgery. During this nine months period we have treated 682 industrial cases and 81 elective cases. Near the end of this paper a table will be shown regarding: number, type, treatment, days treated, results, and time lost.

Because we believe that many times in reading a medical paper one becomes lost in a maze of tabulated figures and percentages, we have tried to make our presentation slightly different from the conventional one in that we have not only listed statistical data but have attempted in the following text to correlate and help interpret the figures appearing in our table. Hence, individual brief analyses of the cases follow:

1. We treated 56 simple lacerations, or abrasions, none severe enough to use sutures. Usually we gave first aid, at which time we cleaned the lacerations and massaged in the tung oil. A repeat visit in 3 days was all that was needed. No time from work was lost by these cases.

2. These 157 lacerations sufficiently severe to require suture were cared for. We cleaned them, poured in the oil and took the number of sutures needed. The sutures were removed in 6-10 days. Only an average of .48 days was lost and there was no infection.

3. We treated 48 cases of severe trauma with lacerations. The wounds were gently cleansed. No sutures were taken, oil was poured in and a light splint was applied to the part. Oil was poured on the laceration every day for 4 days and then every second to third day. Usually in 2 to 4 weeks the injuries were well healed. These patients averaged 9 days' loss of time, compared to 16 days in our previous experience.

4. There were 72 severe traumas with or without small fractures and every one with macerated tissue. A cleansing and moderate débridement was done, then oil poured in and a tobruk-like splint, (aluminum and plaster of paris) with a window was applied. The oil was poured in for 4 days then every second, third, or fourth day. In 4 to 6 weeks all were healed. An average of 21 days was

lost from work—compared to 34 to 40 days by our previous methods.

5. Forty-three small fractures were treated. In these cases the oil was massaged into the injured area and a light splint was applied. This oil was massaged in every other day and a splint re-applied. The patients were healed well enough to return to work in an average of 11 days as compared to 20 days average in previous cases.

6. We had 129 severe sprains and contusions. In these cases we massaged the oil into the wrenched joint and swollen tissues for 15 minutes. This massage was repeated daily, often by the patient. These patients returned to work in an average of 5½ days, as compared to 12 days average healing time for similar cases treated in the past by different methods.

7. Sacro-iliac strains numbered 30, and these were treated with Regen's position, which position is effected on a Gatch bed and simulates a contour chair, sedation and reduced. The oil was then rubbed into the sacro-iliac area for 15 minutes. The patient was given some of the oil and instructed to rub it in twice a day for two or three days. This entire series, with the exception of two, were back at work on one to four days. We had trouble with the two exceptions, but finally cured them over a period of three weeks. This gives us an overall average of 3.3 days and it can be easily seen that if it hadn't been for these two stubborn cases the average healing time would have been one and a half days. The author has observed sacro-iliacs for the past 25 years and says without hesitation that this reduced average work time lost by these 30 cases is difficult for anyone to believe, since his own experience has been that the sacro-iliac patient is usually laid up for 10 to 20 days.

8. This next series of 14 cases demonstrates that processed tung oil is useful on chronic ulcers. The series included 14 contused injuries near old varicose ulcers. These were treated by rubbing the oil into the contused area and also into the ulcer for 15 minutes every day for a week. At the end of the week all patients with the exception of one were sufficiently recovered to return to work. This one exception represents an individual who apparently can live satisfactorily on \$20 a week compensation and we have observed that he is thoroughly uncooperative. In fact, we do not believe that he has any desire to get well. Therefore, it is very annoying to have to add this one case to our list and so affect our overall average,

as this fellow is still under treatment at the end of four months.

9. Similar to the above is the series in which we treated six old sinuses and ulcerations on the skin of the feet and legs associated with old massive compound fractures. In these cases we applied the processed tung oil with a cotton applicator into the depths of the sinus. In one to three months the sinuses were healed. The ulcers were healed in all except one case and that was improved to the extent that the man returned to work at the end of three months. This one patient occasionally gets an exacerbation of his ulcer and he returns to us. We treat him and instruct him, he continues to work, and except for the three months above cited this is all the time he has lost. We contemplated a skin graft but he wouldn't have it. Lost time in this series of six cases averaged only six weeks, which compares very favorably with many other cases treated in the past by other methods, in which we have noted that disability extended, on the average, beyond a four-month period.

10. There were 43 cases that came to us with abscesses, with cellulitis and lymphangitis. We novocainized these and incised them, then swabbed the abscessed areas out with processed tung oil on an applicator. This swabbing process was carried out every other day for six days and at the same time the oil was rubbed into the skin over the reddened and swollen areas. These patients were also given tetanus antitoxin or tetanus toxoid and also one to two ccs. of procaine penicillin. This compared to other cases not treated with tung oil again very favorably, because in the cases treated with tung oil we used only 300,000 to 500,000 units of penicillin, whereas in other cases we have often used 5,000,000 to 10,000,000 units of penicillin. Also these cases were either completely healed, or sufficiently healed for the patients to return to work in an average of from eight to ten days, as compared to other cases observed in the past wherein patients were unable to return to work sooner than on an average of between 15 and 20 days.

11. a.) First degree burns were simply treated by rubbing the oil into the burned area. There were nine of these cases. All healed without any loss of time and one visit was usually sufficient, as in the past. It may be noted, however, that in several instances these burns had occurred on the face. All such face burns were carefully watched for several days, and when healing was com-

plete it was observed that no peeling or redness resulted.

b.) Second degree burns — there were 11 of these. Here we rubbed the oil in gently, for 15 minutes. This alleviated the pain to a large extent, and the process was repeated daily for one week. These patients healed with only reddened scars which scars rapidly disappeared and all patients were back to work in an average of 4.2 days, as compared to an average of 10 days usually required to produce the same result in second degree burns treated by other methods.

c.) Third degree burns of which these were treated by moderate débridement and the oil overlaid on entire burned area. Then a very moderate pressure dressing was applied. These dressings were re-applied every three days and the patients healed with minimal scarring and returned to work in an average of six weeks. This series includes five cases in which small to fairly large skin grafts were necessary. Naturally, these five required a longer healing time and this ran our average to six weeks. But we compare it to similar cases which we have treated in the past and we find that in the cases treated by other methods we were delayed often by infection, by granulations and occasionally failure of the skin graft. Of course, all healed. But we note a comparison in those we treated with processed tung oil which bears out that our healing time on an overall average, compared to a similar number of other cases, was 40 per cent faster; and in none of the burned cases cited here was there any infection, nor was there any failure of a skin graft. When we have sewed in the graft, we overlay it with oil and put on a very moderate pressure dressing, and, unlike the conventional method, we dress it every three days with the oil and moderate pressure dressing.

12. There were 53 punctured wounds. None of these patients lost any time from work. They were all given either tetanus antitoxin or tetanus toxoid and the punctured wound was swabbed out with a tung oil applicator. We have found in the past that in a series of 40 cases of punctured wounds we got infection in approximately 35 per cent. And while these were finally successfully treated, the time lost in this series amounted to an average of five days. We repeat here that in the present 53 cases of punctured wounds which we treated with processed tung oil there was no infection, and no time was lost.

13. We add 81 elective cases to this series.

These represent mainly removal of old scars, moles, cysts, and biopsies of the breast. All these were closed by suture; but before the sutures were taken oil was poured into the fresh wound. There was no infection, healing was entirely primary, and no time was lost. We do not make a comparison to any specific series of previous cases here but we do state that we have never before handled this many elective cases without some infection and some delayed healing. We would also like to add this observation that in the elective cases which we treated with processed tung oil there was considerably less pain and the scars were smaller and less obvious. It is our impression that the tung oil promoted a better, more rapid, and less painful overall repair.

SUMMARY

In summarizing, let us give our impressions and conclusions:

1. We believe that processed tung oil promoted healing and prevented secondary infection in the industrial injuries cited in this paper.

2. We believe that the stimulation of new tissue was promoted so swiftly, that this alone is probably the main reason for the absence of infection noted in our cases.

3. This same stimulating effect is carried to the traumatized nerves and promotes rapid repair toward the normal and therefore relieves sooner the tenderness and soreness and, hence, dulls the acute pain which usually accompanies disabilities such as those described here.

4. We have noted that on the old injuries, ulcers and sinuses the effect of processed tung oil application was more beneficial than other procedures we have used in the past. We cite the same thought here, the same clinical observation only—undoubtedly regeneration of injured tissue was stimulated.

5. We noted that burns treated in this series of cases healed considerably more rapidly than burns treated with anything else we have ever used. Again we believe the tissue repair cycle was greatly aided, and again we mention that no infection was noted.

6. I would like to emphasize that the oil can be overlaid, even on severe burns, without any stinging pain, and our observation has been that these patients continue without much pain until healed. I would further like to bring to your attention that in cases of old ulcers, sprains, swollen joints and lymphangitis the oil should be massaged in for 10 or 15 minutes, not merely applied.

Types of Cases	Number of Cases	Procedure Followed and Applications of Oil	Av. Healing Time	Av. Disability Time Using Tung Oil	Av. Disability Time Tung Oil Not Used
Simple Lacerations	56	Wound left open and oil applied every other day.	3 - 7 Days	Overall average of .48 days lost	same
Simple Lacerations Sutured	157	Wound left open and oil applied every other day.	6 - 10 Days	Overall average of .48 days work lost	2-3 days lost
Severe Trauma with Lacerations	43	Wound left open, light splint applied. Oil applied every day for four days, then every other day.	3 Weeks	Overall average 9 days work lost	16 days lost
Severe Trauma with Small Fractures and Macerated Tissue	72	Wound left open. Tobruk-type cast or splint with window applied. Oil applied every day for 5 days, then every other day.	4 - 6 Weeks	Overall avge. 21 days work lost	34 days lost
Small Fractures	43	Light splint applied, massaged with oil every other day for one week. Splint removed in one week, oil then massaged into fracture area every 3 days.	3 - 4 Weeks	Overall avge. 11 days work lost	17 days lost
Severe Sprains and Contusions	129	Oil massaged into wrenched joint and swollen tissues for 15 minutes. Massage repeated daily, often by patient.	7 - 12 Days	Overall avge. 5¾-days work lost	12 days lost
Sacro-Iliac Strains	30	Regens position, sedation, reduced, and then oil massaged into back at sacro-iliac area for 1 to 5 days.	1 - 5 Days	Overall avge. of 3.3 days work lost	12 days lost
Varicose Ulcers with Recent Industrial Injury	14	Treated the recent injury, which in these 14 cases were contusions, and also the ulcer area daily for 3-8 days.	In 3 to 8 Days	13 of these healed in an avge. time of 5 days. With improvements in ulcer.	3 weeks lost
Old Sinuses and ulcerations on skin of feet and legs associated with old massive compound fractures	6	Novacainized and curettement of sinuses; oil then poured into curretted sinuses daily for 5 days, after that twice a week	1 - 3 Months	Overall avge. 6 weeks work lost	4 months
Abscesses with Cellulitis and Lymphangitis	43	Abscesses incised. Oil poured into abscessed area, cellulitis given gentle massage with oil, daily.	1½ - 16 Days	Overall avge. 8 days work lost	15 days
First Degree Burns	9	Oil applied one day, patient told to use it several days.		No time lost	Same
Second Degree Burns	11	Oil applied daily for 3 to 6 days, patient told to continue using it.	3 - 6 Days	Overall avge. 4½ days work lost	9 days
Third Degree Burns	11	Mild débridement, oil applied to burned area moderate pressure dressing. (It was necessary to graft skin in 5 of these cases.) Burns dressed every 2 to 3 days, and oil applied. Also 5 grafts dressed every 3 days and oil applied.	2½ - 8 Weeks	Overall avge. 6½ week work lost	3 months
Punctured Wounds	53	Oil rubbed in one time and applied to depth of wound.	1 Day	No time lost	3-4 days
Elective Cases, Chiefly removal of old scars, moles, cysts, and biopsies of breasts. All closed by suture	81	Oil poured into fresh wound, then suture taken. Sutures removed on 6 to 10th day. No infection. All healing primary.		No time lost	5 days

NOTE: T.A.T. 1500 units, or T.T. 1 c.c. was given in virtually every case. Only in the 43 abscesses with cellulitis and lymphangitis cases were 300,000 to 500,000 units of procaine penicillin given.

7. Our experience in this series of 763 cases, as compared with our records of cases treated by other methods as used in the past, indicates this one constant fact—complete healing and disability time was reduced 50 per cent. This alone is of tremendous importance, as it represents the potential saving of thousands of man hours. It is apparent from the chart and from a comparison of our own experience in the past that in the 763 cases discussed here we have reduced work time lost by disability from one day in several cases to as much as 21 days in aggravated cases.

During the past few years, nearly every state has passed compensation laws. These laws usually provide that if an injured employee is absent from work one week he is paid by the insurance carrier for two days; but if this same employee is absent from work for 14 days, he is paid for two full weeks and is paid week by week thereafter until his disability terminates. The amount of compensation the employee receives is based on a percentage of his payroll earnings. The lowest amount he can receive weekly is \$12 and the maximum is \$25.

We cannot help but remark at this point that the number of man hours which has been saved in this series represents the saving of several thousands dollars to the insurance carrier and therefore to the employer himself. But let us further note that it represents also a saving of a great deal of money to the employee, as well,

since he makes just about three times as much when he works his full week as when he is on the compensation list.

Gentlemen, this ends our paper. But let us quote Alexander Pope:

"Be not the first by whom the new is tried,
Nor yet the last to lay the old aside."

Since this series shows how thoroughly we have tried this new material it is our hope that this account of our experience can be of benefit to you, also.

ACKNOWLEDGEMENTS

1. Oil which was treated by this process was furnished by the Tungolin Company, Inc., Gulfport, Miss. This processed tung oil is not expensive, the supply can be considered inexhaustible. In the author's opinion this is the most inexpensive medicinal aid he has employed throughout the years.
2. *Journal of Pharmacology and Experimental Therapeutics*, Vol. 84, pp. 128-135—1945. U. S. Dispensatory, 1907 Edition, refers to tung oil: "It is also used medicinally as an application in skin-diseases, ulcers, etc."
3. Hertkorn, *Chemical Rev.*, page 635—1903; M. W. Swaney, *Indus. and Engin. Chem. (Indus. Ed.)* 30: 514-515, May, '38.
4. *Ibid.*
5. *Ibid.*
6. "Tung Oil." Ph.D. Thesis, by James Claude Thomson, Columbia University, 1933.
7. *Ibid.*
8. Report by Foster N. Martin, Jr., M.D., Dept. Pharmacology, Tulane University School of Medicine, February 18, 1952, to the Tung Growers Council of America tung oil toxicity study.
9. Tests conducted for Tungolin Company, Inc., Gulfport, Miss.