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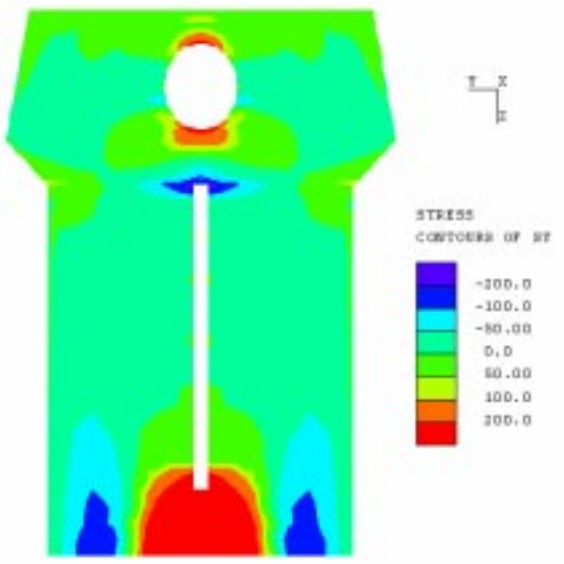
Inspection Intervals For Components

The majority of component failures in lower limb prosthetics are fatigue related. Usually the first indication of a failure in the components is when the amputee returns to the clinic with a broken prosthesis. Of component failures presented to **REHAB*Tech*** only 6.9% had been removed prior to breakage. These component failures can have many consequences, including the amputee falling with possible subsequent injuries.

The best way to avoid fatigue failure is regular inspection and, when appropriate, replacement of components. The need for accurate component inspection times is required as if they are too infrequent, failure can occur between inspections and if too frequent they become costly, both in time and money.

A limited study conducted at **REHAB*Tech*** looks at determining the expected life and inspection intervals for two commonly used components. One a 30 mm Aluminium pylon (one of the more common failures) and the other a Titanium pylon adapter (these have not been reported as failing, but assumed to be being replaced too frequently).



A review of failed components is used to determine the conditions of a typical failure. Cracks are initiated in the two components which are cyclically tested with realistic loads. FEM analysis and crack growth analysis are used to build a model of the expected life of the components. This model is compared to the cyclic test results and manufacturer's testing. The model is then used to determine appropriate inspection intervals.

The fatigue life of the pylon for different activity levels and amputee weights was determined. The activity levels considered were AOPA levels K2, moderate activity, and K3, high activity. For a 120 kg amputee, even 100 Kg at K3 level, the 30 mm pylon with a 2 mm wall thickness is not really suitable and other pylons should be considered.

Activity levels K1 and K4 were not considered. K1 is very low activity. Inspection need only take place during routine visits. The K4 level is for a very active adult or athlete. It would be expected the demands for this activity level will be different for each amputee, so each case should be considered separately.

Activity level/ Amputee weight	K3, cycles (days)	K2, cycles (days)
80 Kg	10^6 (200)	1.5×10^6 (300)
100 Kg	5×10^5 (100)	10^6 (200)
120 Kg	2.5×10^5 (50)	5×10^5 (100)

Table 1, Recommended Inspection Intervals for a 30 mm pylon.

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For the pylon a fatigue crack grows transversely at a faster rate than internally. The crack only penetrates the pylon towards the end of the pylon's life. Therefore internal inspection of the pylon is of little use.
The fatigue life of the pylon adapter turned out to be very interesting. From experience it was assumed it would have a very long fatigue life. When a crack had developed it propagated very quickly to failure. A life expectancy of less than 100 days once a crack occurred was common. However the time for initiation was theoretically infinite.
Even with a notch placed in the pylon adapter initiation still took a very long time. This suggests that the pylon adapter has great resistance to crack initiation, but little resistance to crack growth. This is reflected in failed adapters, the majority being Aluminum which has lower resistance to crack initiation, or stainless steel. The failures when they have occurred have been very quick, often less than 3 months.
This suggests the pylon adapter should be inspected along with other components. If any damage is present replace the pylon adapter. Total life of the adapter can be seen in Table 2 for different amputee weights and activity levels.
This suggests the Titanium pylon adapter can be maintained in use for a long time provided regular inspections take place.

Amputee weight/ Activity level	K3 cycles	K2
80 Kg	6.2×10^8	indeterminate
100 Kg	4.5×10^7	1.0×10^8
120 Kg	7.4×10^6	9.2×10^6

Table 2 Life of Titanium Pylon Adapters

For further information contact **REHAB*Tech*.**

Remember these are a guide only. Always follow any component manufacturers instructions.

REHAB*Tech* Services Review

A Review of **REHAB*Tech*** services will be taking place soon. We will appreciate your feedback to improve our services in the future.

WALSA website.

The Western Australian Limb Service for Amputees has a new web site. It can be accessed at http://www.health.wa.gov.au/walsa/

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COMING EVENTS

1st - 6th July 2001	**10th World Congress of the International Society for Prosthetics and Orthotics, Glasgow, Scotland** ispo@meetingmakers.co.uk
2nd - 4th October 2001	**Australian Rehabilitation and Assistive Technology Association, ARATA, Conference. Email arata2001@im.com.au**

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