Cemented total hip replacement for primary osteoarthritis in patients aged 55 years or older

RESULTS OF THE 12 MOST COMMON CEMENTED IMPLANTS FOLLOWED FOR 25 YEARS IN THE FINNISH ARTHROPLASTY REGISTER

We have analysed from the Finnish Arthroplasty Register the long-term survivorship of the 12 most commonly-used cemented implants between 1980 and 2005 in patients aged 55 years or older with osteoarthritis. Only two designs of femoral component, the Exeter Universal and the Müller Straight femoral component had a survivorship of over 95% at ten years with revision for aseptic loosening as the endpoint. At 15 years of the femoral and acetabular component combinations, only the Exeter Universal/Exeter All-poly implant had a survival rate of over 90% with revision for aseptic loosening as the endpoint. In the subgroup of patients aged between 55 and 64 years, survivorship overall was less than 90% at ten years. The variation in the long-term rates of survival of different cemented hip implants was considerable in patients aged 55 years or older. In those aged between 55 and 64 years, none of the cemented prostheses studied yielded excellent long-term survival rates ($\geq 90\%$ at 15 years).

Charnley’s cemented low-friction hip replacement is still considered to be the ‘gold standard’, against which new hip implants are compared. A survival rate exceeding 90% at ten years is commonly regarded as a good long-term outcome while the 25-year survival rate of 80% has remained unsurpassed. According to the long-term results obtained from the Scandinavian Arthroplasty Registers, cemented total hip replacement (THR) is the treatment of choice for osteoarthritis of the hip in older patients. However, in a recent study, using data from the Finnish Arthroplasty Register, it was concluded that cementless hip replacements had a lower risk of revision for aseptic loosening than cemented implants in osteoarthritic patients aged from 55 to 74 years.

We have analysed the long-term survival rates of contemporary cemented implants used for primary osteoarthritis in patients aged 55 years and older using the population-based data recorded in the Finnish Arthroplasty Register between 1980 and 2005.

Patients and Methods

Data on THRs have been collected and archived in the Finnish Arthroplasty Register since 1980. Health-care authorities and orthopaedic units are obliged to provide the National Agency for Medicines with information for inclusion in the register. The coverage of the Finnish Arthroplasty Register for 1994 to 1995 was 90% when compared with hospital discharge registers. Since 1995, the data of the register have been analysed every few years. Currently, 98% of all hip replacements are recorded.

During the period of study, 101 720 primary THRs were performed in Finland. Of these, 87 578 (86%) were on patients aged 55 years or older. Primary osteoarthritis was the indication for operation in 71 146 (81%) of these operations. In 41 034 (58%) of the 71 146 procedures cemented hip replacements were used.

We included patients aged 55 years or older at the time of the primary operation with primary osteoarthritis as the recorded indication for operation. Survival analyses were performed both for the whole study population and separately for three different age groups: 55 to 64 years, 65 to 74 years and 75 years and older. Only cemented designs which had been used in more than 500 operations during the period of study were included, which allowed the inclusion of 12 combinations of acetabular and femoral components which had been used in a total of 34 549 operations. The details of these 12 implants are presented in Table I and design-specific data are shown in Table II.
Revisions were linked to the primary operation using a personal identification number. The numbers and indications for revisions were recorded (Table III).

**Statistical analysis.** The statistical analyses were carried out using SPSS version 14.0 software (SPSS Inc., Chicago, Illinois). The endpoint for survival was defined as revision when any component, including the femoral head and liner, or the whole implant was removed or exchanged. Survivorship of the femoral and acetabular components were analysed with revision for aseptic loosening as the endpoint.

When survival analyses were carried out, both revision for any reason and revision for aseptic loosening served as discrete endpoints. Kaplan-Meier survival analysis was used to calculate the probabilities of survival of an implant at five, ten, 15 and 20 years. The survival rates of implants were determined only when there were at least 20 hips at risk at the point of follow-up. The survival data obtained by Kaplan-Meier analyses were compared using the log-rank test. The Cox multiregression model was used to study differences between groups and adjust for
Table III. Reasons for revision of the 12 most common cemented and all other total hip replacements

<table>
<thead>
<tr>
<th>Implant</th>
<th>Number of primary operations</th>
<th>Loosening (cup + femoral component) (%)</th>
<th>Aseptic loosening (cup) (%)</th>
<th>Aseptic loosening (femoral component) (%)</th>
<th>Infection (%)</th>
<th>Dislocation (%)</th>
<th>Malposition (%)</th>
<th>Fracture of prosthesis (%)</th>
<th>Peri-prosthetic fracture (%)</th>
<th>Another reason (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>36 597</td>
<td>919 (21.5)</td>
<td>1074 (25.1)</td>
<td>891 (20.8)</td>
<td>141 (3.3)</td>
<td>385 (9.0)</td>
<td>117 (2.7)</td>
<td>80 (1.9)</td>
<td>199 (4.6)</td>
<td>474 (11.1)</td>
<td>4280</td>
</tr>
<tr>
<td>Elite Plus</td>
<td>885</td>
<td>28 (6.9)</td>
<td>7 (6.7)</td>
<td>53 (51.0)</td>
<td>2 (1.9)</td>
<td>4 (3.8)</td>
<td>3 (2.9)</td>
<td>1 (0.1)</td>
<td>6 (5.8)</td>
<td>0 (0.0)</td>
<td>104</td>
</tr>
<tr>
<td>Lubinus IP</td>
<td>5790</td>
<td>464 (51.1)</td>
<td>150 (16.5)</td>
<td>225 (24.8)</td>
<td>25 (2.8)</td>
<td>5 (0.7)</td>
<td>10 (1.1)</td>
<td>15 (1.7)</td>
<td>8 (0.0)</td>
<td>908</td>
<td></td>
</tr>
<tr>
<td>Lubinus SP II/Lubinus IP</td>
<td>7240</td>
<td>161 (26.7)</td>
<td>96 (16.0)</td>
<td>178 (32.9)</td>
<td>24 (4.0)</td>
<td>4 (4.4)</td>
<td>1 (0.2)</td>
<td>19 (3.2)</td>
<td>14 (2.3)</td>
<td>602</td>
<td></td>
</tr>
<tr>
<td>Lubinus SP II/Lubinus FC</td>
<td>701</td>
<td>4 (22.2)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>6 (33.3)</td>
<td>8 (44.4)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Lubinus SP II/Lubinus Eccentric</td>
<td>2693</td>
<td>30 (19.7)</td>
<td>23 (15.1)</td>
<td>58 (36.2)</td>
<td>11 (22)</td>
<td>16 (10.5)</td>
<td>6 (3.9)</td>
<td>0 (0.0)</td>
<td>3 (2.0)</td>
<td>5 (3.3)</td>
<td>152</td>
</tr>
<tr>
<td>Exeter All-poly</td>
<td>986</td>
<td>73 (42.7)</td>
<td>28 (16.4)</td>
<td>46 (26.9)</td>
<td>2 (1.2)</td>
<td>4 (2.3)</td>
<td>1 (0.6)</td>
<td>7 (4.1)</td>
<td>8 (4.7)</td>
<td>2 (1.2)</td>
<td>171</td>
</tr>
<tr>
<td>Exeter Universal/Exeter All-poly</td>
<td>5048</td>
<td>34 (14.4)</td>
<td>57 (24.2)</td>
<td>29 (12.3)</td>
<td>26 (11.9)</td>
<td>46 (19.5)</td>
<td>11 (4.7)</td>
<td>0 (0.0)</td>
<td>23 (9.7)</td>
<td>8 (3.4)</td>
<td>236</td>
</tr>
<tr>
<td>Müller Straight/Müller Std</td>
<td>5572</td>
<td>10 (7.1)</td>
<td>21 (15.0)</td>
<td>10 (7.1)</td>
<td>19 (13.6)</td>
<td>52 (37.7)</td>
<td>9 (6.4)</td>
<td>0 (0.0)</td>
<td>14 (10.0)</td>
<td>5 (3.6)</td>
<td>140</td>
</tr>
<tr>
<td>Spectrum EF/Reflection All-poly</td>
<td>1929</td>
<td>4 (12.1)</td>
<td>6 (18.2)</td>
<td>2 (6.7)</td>
<td>9 (27.3)</td>
<td>10 (30.3)</td>
<td>1 (3.0)</td>
<td>0 (0.0)</td>
<td>1 (3.0)</td>
<td>0 (0.0)</td>
<td>33</td>
</tr>
<tr>
<td>Biomet Interlok/Müller Müller</td>
<td>581</td>
<td>14 (24.6)</td>
<td>11 (19.3)</td>
<td>21 (36.8)</td>
<td>3 (5.3)</td>
<td>2 (3.5)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>4 (7.0)</td>
<td>2 (3.5)</td>
<td>57</td>
</tr>
<tr>
<td>Charnley/Charnley LPW*</td>
<td>925</td>
<td>79 (41.1)</td>
<td>18 (9.4)</td>
<td>66 (34.4)</td>
<td>8 (4.2)</td>
<td>5 (2.6)</td>
<td>0 (0)</td>
<td>3 (1.6)</td>
<td>5 (2.6)</td>
<td>8 (4.2)</td>
<td>192</td>
</tr>
<tr>
<td>Together</td>
<td>71 146</td>
<td>1886 (26.6)</td>
<td>1537 (21.7)</td>
<td>1654 (23.3)</td>
<td>292 (4.7)</td>
<td>611 (8.6)</td>
<td>173 (2.4)</td>
<td>106 (1.5)</td>
<td>302 (4.3)</td>
<td>528 (7.4)</td>
<td>7089</td>
</tr>
</tbody>
</table>

*LPW, long posterior wall

Potential confounding factors. Revision risk ratios of the femoral and acetabular components and of the THR were analysed. Adjustments were made for age and gender.17 The Charnley was chosen as the reference prosthesis because it is still considered to be the ‘gold standard’ in hip replacement.3-8 Cox regression analyses provided estimates of probabilities of survival and adjusted risk ratios for revision. The estimates derived from Cox analyses were used to construct adjusted survival curves at mean values of the risk factors. The Wald test was used to calculate the p-values for data obtained from the Cox multiple regression analyses. Differences between groups were considered to be statistically significant if the p-value was less than ≤ 0.05 in a two-tailed test.

Results

Survival of the femoral components. When all patients aged 55 years or more were analysed, the survival rate at 15 years was 96% for the Exeter Universal femoral component and 79% for the Charnley femoral component. Cox regression analysis showed that five designs had a significantly lower risk of revision when compared with the reference design, i.e. the Charnley femoral component (Table IV, Fig. 1).

In patients aged between 55 and 64 years, the Exeter Universal femoral component had a survivorship at ten years which exceeded 95% and at 15 years of more than 90% (Table IV).

In patients aged between 65 and 74 years, survivorship of the Exeter Universal and the Müller Straight femoral components exceeded 90% at 15 years (Table IV).

In patients aged 75 years and older, all femoral components (excluding spectrum) showed survivorship of over 90% at ten years (Table IV).

Survival of the acetabular component. At 15 years only the Exeter All-poly and the Müller Standard acetabular components exceeded survivorship of 90% when all patients aged 55 years or more were analysed. Cox regression analysis showed that three acetabular components had a significantly reduced risk of revision when compared with the Charnley reference design (Fig. 2).
### Table IV. Survival at 5, 10, 15 and 20 years of the cemented femoral components with an endpoint of revision because of aseptic loosening of the femoral component

<table>
<thead>
<tr>
<th>Age group (yrs)</th>
<th>Femoral component brand</th>
<th>Number of patients</th>
<th>MF² (yrs)</th>
<th>AR² (0 % 5-yr survival (95% CI))</th>
<th>AR (10 yrs) % 10-yr survival (95% CI)</th>
<th>AR (15 yrs) % 15-yr survival (95% CI)</th>
<th>AR (20 yrs) % 20-yr survival (95% CI)</th>
<th>Adjusted RR¹ for revision (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 75</td>
<td>Elite Plus</td>
<td>316</td>
<td>5.9</td>
<td>210 (92 to 98)</td>
<td>37</td>
<td>96 (90 to 98)</td>
<td>-</td>
<td>88 (90 to 98)</td>
<td>89%</td>
</tr>
<tr>
<td></td>
<td>Lubinus IP</td>
<td>1332</td>
<td>9.7</td>
<td>1095 (97 to 99)</td>
<td>37</td>
<td>96 (95 to 97)</td>
<td>-</td>
<td>88 (90 to 98)</td>
<td>89%</td>
</tr>
<tr>
<td></td>
<td>Lubinus SP II</td>
<td>4136</td>
<td>6.4</td>
<td>248 (98 to 99)</td>
<td>97</td>
<td>96 (99 to 98)</td>
<td>-</td>
<td>88 (90 to 98)</td>
<td>88%</td>
</tr>
<tr>
<td></td>
<td>Exeter</td>
<td>195</td>
<td>9.5</td>
<td>160 (98 to 100)</td>
<td>94</td>
<td>94 (90 to 98)</td>
<td>-</td>
<td>88 (90 to 98)</td>
<td>89%</td>
</tr>
<tr>
<td></td>
<td>Exeter Universal</td>
<td>4439</td>
<td>3.8</td>
<td>1589 (100 to 100)</td>
<td>222</td>
<td>98 (97 to 99)</td>
<td>-</td>
<td>87 (97 to 98)</td>
<td>96%</td>
</tr>
<tr>
<td></td>
<td>Müller Straight</td>
<td>704</td>
<td>8.8</td>
<td>581 (100 to 100)</td>
<td>323</td>
<td>99 (98 to 100)</td>
<td>-</td>
<td>86 (97 to 100)</td>
<td>94%</td>
</tr>
<tr>
<td></td>
<td>Spectrum</td>
<td>862</td>
<td>1.6</td>
<td>32 (98 to 100)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 (98 to 100)</td>
<td>90%</td>
</tr>
<tr>
<td></td>
<td>Biomet Interlok</td>
<td>239</td>
<td>6.5</td>
<td>162 (95 to 99)</td>
<td>48</td>
<td>94 (91 to 98)</td>
<td>-</td>
<td>88 (97 to 100)</td>
<td>94%</td>
</tr>
<tr>
<td></td>
<td>Charnley</td>
<td>171</td>
<td>8.4</td>
<td>131 (96 to 100)</td>
<td>79</td>
<td>95 (91 to 99)</td>
<td>-</td>
<td>87 (98 to 100)</td>
<td>93%</td>
</tr>
<tr>
<td>All (≥ 55)</td>
<td>Elite Plus</td>
<td>885</td>
<td>6.3</td>
<td>622 (92 to 96)</td>
<td>134</td>
<td>85 (81 to 90)</td>
<td>-</td>
<td>88 (88 to 96)</td>
<td>88%</td>
</tr>
<tr>
<td></td>
<td>Lubinus IP</td>
<td>5790</td>
<td>12.0</td>
<td>5094 (97 to 97)</td>
<td>3682</td>
<td>91 (90 to 91)</td>
<td>2147</td>
<td>85 (84 to 96)</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>Lubinus SP II</td>
<td>10634</td>
<td>7.2</td>
<td>7352 (98 to 97)</td>
<td>3242</td>
<td>94 (94 to 95)</td>
<td>2147</td>
<td>85 (84 to 96)</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>Exeter</td>
<td>876</td>
<td>11.6</td>
<td>760 (95 to 98)</td>
<td>540</td>
<td>89 (87 to 92)</td>
<td>2147</td>
<td>85 (84 to 96)</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>Exeter Universal</td>
<td>10620</td>
<td>4.3</td>
<td>4280 (99 to 99)</td>
<td>832</td>
<td>98 (97 to 98)</td>
<td>2147</td>
<td>85 (84 to 96)</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>Müller Straight</td>
<td>2309</td>
<td>10.7</td>
<td>2010 (97 to 99)</td>
<td>1451</td>
<td>96 (95 to 97)</td>
<td>505</td>
<td>88 (85 to 92)</td>
<td>92%</td>
</tr>
</tbody>
</table>
In patients aged between 55 and 64 years, the Exeter All-poly was the only acetabular component with a significantly lower risk of revision than the Charnley long posterior wall implant.

In patients aged between 65 and 74 years, the Exeter All-poly and the Müller Standard acetabular component had a significantly lower risk of revision than the Charnley long posterior wall.

In patients 75 years and older, all acetabular components with available follow-up data, except the Exeter Metal-backed, had survival rates of 95% or more at ten years.

Survival of the total hip replacement: aseptic loosening. At 15 years, Exeter All-poly THR was the only design with a survivorship which exceeded 90% when all patients aged 55 years or more were analysed. Cox regression analysis showed that the Elite Plus prosthesis had a higher risk of revision than the Charnley (Fig. 3).

In patients aged between 55 and 64 years, the survival rate at 15 years of the Exeter Universal/Exeter All-poly prosthesis was 84%. The Charnley prosthesis had a survival rate of 55% at 20 years.
In patients aged between 65 and 74 years, the survival rates at 15 years of both the Exeter Universal/Exeter All-poly and the Müller prostheses exceeded 90%.

In patients aged 75 years or older, three designs had a substantially lower risk of revision than the Charnley prosthesis, the Exeter Universal/Exeter All-poly, the Exeter Universal/Exeter Contemporary, and the Müller Straight/Müller Standard.

Survival of the total hip replacement designs: all revisions. When all patients aged 55 years or more were analysed, both the Exeter Universal/Exeter All-poly and the Müller prostheses had a survival rate of 88% at 15 years. In the Cox model, five designs had a significantly reduced risk of revision when compared with the Charnley prosthesis.

In patients aged between 55 and 64 years, the Exeter Universal/Exeter All-poly designs had a survival rate of 80% at 15 years.

In patients aged between 65 and 74 years, survivorship at 15 years exceeded 85% in only the Exeter Universal/Exeter All-poly and the Müller prostheses.

In patients aged 75 years or older, three designs had a lower risk of revision than the Charnley prosthesis namely the Lubinus IP/Lubinus IP, the Lubinus SPII/Lubinus Eccentric and the Müller Straight/Müller Standard.

Discussion

We found considerable differences in the long-term survival of cemented prostheses in patients aged 55 years or older in Finland. Survivorship of the Exeter Universal/Exeter All-poly and the Müller prostheses exceeded those of other designs in most analyses. The outcome of the Charnley prosthesis was worse than that of most other designs. Only the Elite Plus prosthesis had a lower survival rate than the Charnley. In the youngest age group, long-term survivorship of cemented prostheses was less than optimal and clearly worse than previously reported from single centres.3-8

Register-based studies have certain limitations. The coverage of the Finnish Arthroplasty Register before 1994 to 1995 was only 90%. Thus 10% of the data before 1994 are missing. This may be a cause of bias in our study. It is also possible that a small number of centres performed most of the hip replacements using certain implants. However, a single centre with poor results is unlikely to have a major effect on the results in a study such as this with large numbers of implants. Moreover, it is the purpose of register studies to evaluate population-based results with hospitals of variable standards. A limitation of registry-based studies is that the only definition of failure of an implant is a revision operation. There may also be patients with osteolysis or loosen implants who are too ill to undergo revision surgery or who simply prefer not to do so. The implantation of different hip prostheses varied over the years (Table I), and in some studies, modern cementing techniques have resulted in higher long-term survival9,18 compared with earlier methods. However, this has not been verified in all studies.10

In our study the long-term results of the Charnley prosthesis were not as good as those published previously.3-5 Only the Elite Plus prosthesis, which is a modification of the Charnley prosthesis, had a poorer long-term outcome than the Charnley prosthesis. The number of Charnley prostheses implanted in Finland was small (925) compared with the Exeter Universal/Exeter All-poly prosthesis (5048). There may be some bias regarding the centres in which these operations took place. The Charnley prosthesis may also have been affected by the cohort effect. The use of Exeter Universal/Exeter All-poly prosthesis in Finland began nine years later than that of the Charnley prosthesis.
Furthermore, when we analysed the 12 most common designs of implant only those Charnley femoral components which were implanted together with the long posterior wall acetabular component were included. Combinations of other acetabular components, such as the Charnley Standard, were not included, because they were not among the 12 most common implants used in Finland. The long posterior wall acetabular component has been shown to generate twice as much torque as the standard acetabular component and therefore is more likely to loosen.19 The poor results of this particular acetabular component may have worsened the results for the Charnley femoral component.

The Lubinus prosthesis has been widely used in both Finland and Sweden.9,11 However, long-term survival rates of this prosthesis have been contradictory.9-11,20,21 In our study the long-term survival was not as good as that of the best-performing designs. When all revisions were taken into account, the survival rate at ten years of the Lubinus SP II/Lubinus IP prosthesis was 88% in patients aged between 55 and 64 years, but at 15 years it had declined to 73%. This finding emphasises the importance of continual surveillance and reporting of the results of hip implants beyond follow-up of ten years.

The long-term survivorship of the matt-finished Exeter femoral component combined with the metal-backed cemented acetabular component was poor. By contrast, that of the Exeter Universal/Exeter All-poly THR was good. These results are in accordance with previous reports.8,9,22-24

In our study, the long-term survival of the Müller prosthesis was good in patients aged over 64 years in agreement with previously published results.25,26

The long-term survival of the Elite Plus prosthesis was poor reflecting previous findings.27,28 The changes in the Elite Plus femoral component over those of the Charnley femoral component included a modification of the shoulder flange to reduce subsidence,29 an altered geometry of the femoral component, an altered surface finish, improved material and new instrumentation.30 Furthermore, catastrophic failures of the Elite Plus component with a Hylamer acetabulum and zirconia ceramic femoral head have also been reported.31 However, all-poly Hylamer acetabular components have not been used in Finland. There seems to be no reason to continue using the Elite Plus hip implant.

The combination of the Spectron EF femoral component and the Reflection All-poly acetabular component has become very popular in Finland, despite the fact that long-term results for this design are not yet available. In our study, the short-term results for this implant were promising. This is in accordance with previous data for the older version of the femoral component, the satin Spectron femoral component.9,32,33 The modified version of the Spectron femoral component, the Spectron EF, was introduced in 1989 with the addition of a distal centraliser, head modularity and a rough surface finish in the proximal third.34 In Finland, only the roughened version has been used. High rates of failure for the Spectron EF femoral component have recently been published.34,35 This aseptic failure, which is characterised by debonding, subsidence and metal shedding with femoral osteolysis and metallosis, has not been reported for the satin finish Spectron femoral component.35 Longer follow-up is needed to determine if there is any difference in survivorship between the satin-finished Spectront and the Spectron EF femoral component.

In our study, the long-term survival rates of cemented prostheses in patients aged between 55 and 74 years were not as good as those previously reported from single centres,1,3-7 whereas some registry studies have better results.9,10 However, almost all cemented designs did well in patients aged more than 75 years. It has been stated previously that cemented prostheses have a higher risk of revision for aseptic loosening than cementless implants in patients aged between 55 and 74 years who have osteoarthritis.12 The potential reasons for the relatively poor long-term survivorship of cemented hip designs in Finland are unclear. Hip replacements have been performed in numerous low-volume hospitals in Finland until recently and third-generation cementing techniques may not have been widely adopted among Finnish orthopaedic surgeons during the 1990s. Moreover, cementing techniques have only been categorically documented in the Finnish Register since 1996.

In an earlier study using data from the Finnish Arthroplasty Register12 it was found that composite-beam36,37 femoral components had a significantly increased risk of revision for aseptic loosening as compared to the loaded-taper femoral components. The Exeter Universal femoral component, which is a loaded-taper femoral component, also had good survival rates in patients in the youngest age group in our study.

Our findings indicate that there were considerable differences in the long-term survival of cemented prostheses in patients aged 55 years or older on a nationwide level. The Exeter Universal/Exeter All-poly design had the best long-term outcome in Finland. However, none of the cemented prostheses could provide the youngest age group of patients with excellent long-term survival (≥ 90% at 15 years). All cemented designs produced a reliable outcome in terms of low revision rates in patients older than 74 years.

Supplementary material

Further tables showing survival rates of the components 5, 10, 15 and 20 years are available with the electronic version of this article on our website at www.jbjs.org.uk

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References


